PETROLEUM PROCESSING

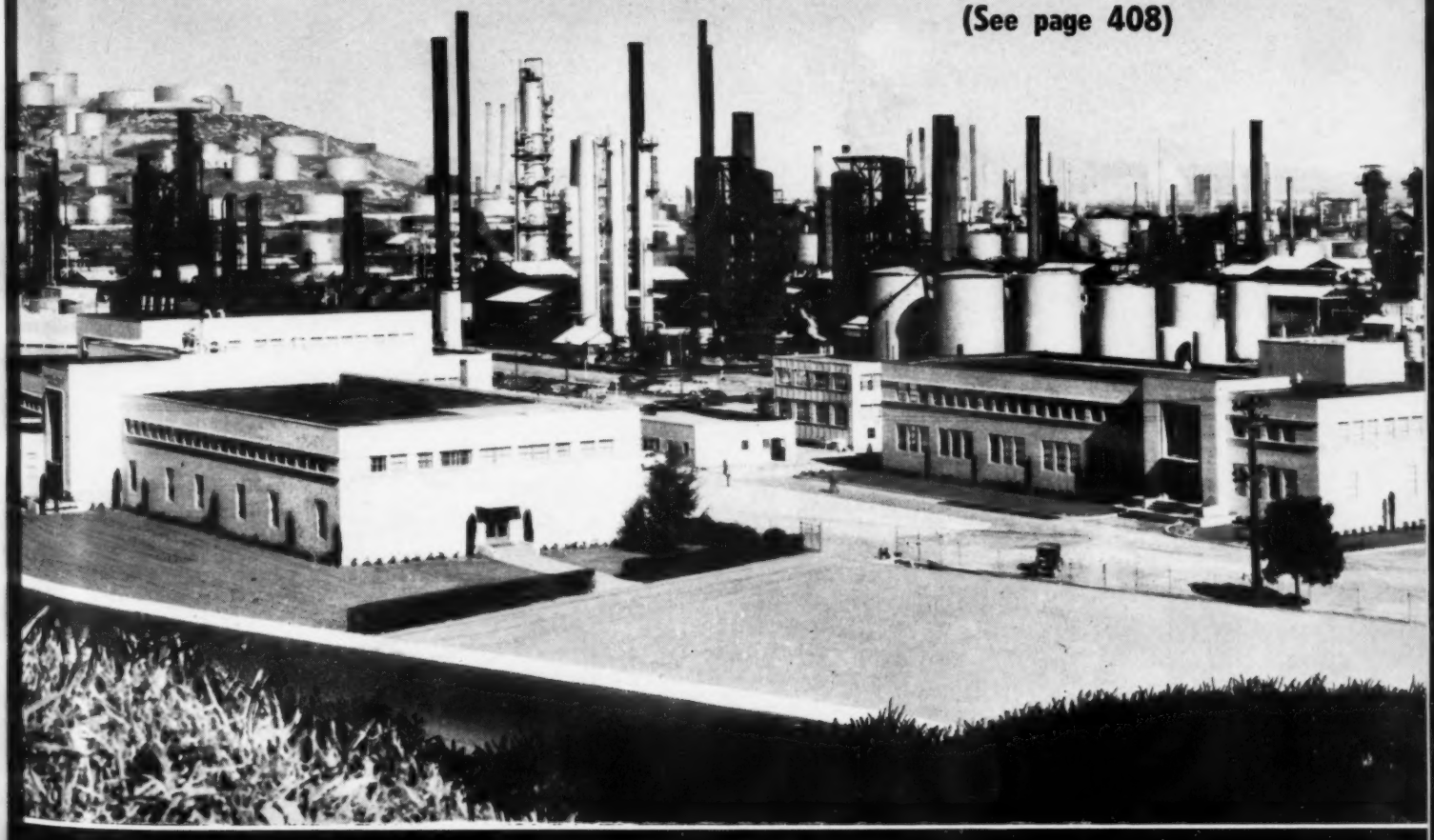
J 9 1948
DETROIT

VOLUME 3, NUMBER 5 MAY, 1948

CHNOLOGY DEPARTMENT

New Research Laboratory In Refinery Foreground

(See page 408)



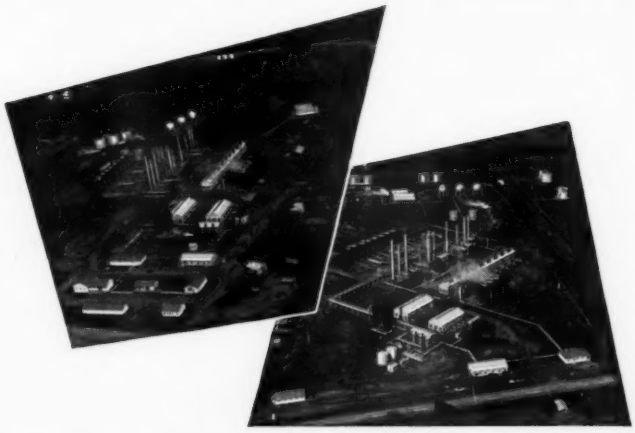
FORMERLY MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS

Two New

Gas Processing Plants

BUILT BY HUDSON

for The California Company



To these two plants at Cranfield, in Mississippi, and Lake St. John, in Louisiana, will pass many millions of barrels of crude oil, many billions of cubic feet of gas—the total recoverable reserves in each field. In such long-lived operations, quality of design and construction to insure continuing high plant recoveries, minimum down time, and minimum operating cost are of paramount importance. The two plants, complete with field piping systems, were designed and constructed by HUDSON in collaboration with The California Company, the unit operator for each field.

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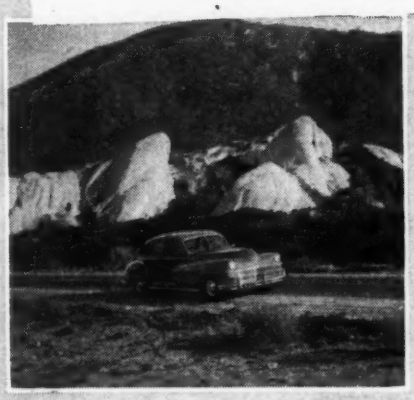
GAS COMPRESSOR STATIONS • CYCLING PLANTS • GAS DEHYDRATION PLANTS • NATURAL GASOLINE PLANTS FRACTIONATION UNITS • CRUDE TOPPING UNITS • PRESSURE MAINTENANCE PLANTS • HYDROGEN SULPHIDE REMOVAL PLANTS • ATMOSPHERIC AND VACUUM DISTILLATION UNITS

THE ETHYL CORPORATION SERVES THE PROGRESSIVE PETROLEUM INDUSTRY *Through Research*



Ethyl's San Bernardino Laboratory is located close to mountains and deserts. Here the resultant wide ranges of weather and topography are ideal for nearly all types of research on the road.

ROAD PERFORMANCE

... *the final proof of antiknock quality*

DETERMINATION of customer acceptance of fuels is complicated by continuous progress in the development of automotive engines and of fuel refining processes. Each advance in engine design is likely to result in some reversals of fuel preferences. Each new refining process usually yields a product which exhibits some unfamiliar type of antiknock performance.

To determine the performance of gasoline in cars driven by the general public today and to predict their performance in cars produced in the future, road tests are necessary. Conventional laboratory knock tests alone are not completely dependable indicators of the performance of fuels in service. Accurate road knock ratings are essential, not only on current commercial products, but also on future fuels which refiners may produce through variations in the operation of existing processes or by the installation of new equipment.

In the appraisal of fuel antiknock quality under actual service conditions, the Ethyl Research Laboratories cooperate closely with the engineering departments of motor vehicle manufacturers. As a result Ethyl's engineers are able to choose a limited number of vehicles in which fuel knocking is suitably representative of the range of current engines, and to use some vehicles having engines which are modified to permit the rating of fuels likely to be required two or three years hence.

Accuracy Vital in Knock Rating

When only a few vehicles are employed for the knock rating of a given fuel, the accuracy of each observation must be of the highest order. Accordingly, the Ethyl Laboratories have installed in the test cars the finest instruments which they have been able to develop or procure for the indication of engine operating conditions during the conduct of knock tests. Special equipment permits frequent and convenient calibration of the installed instruments.

Ethyl technical employees who plan and carry out cooperative knock rating studies with refiners have the benefit of extensive experience and a broad background relating to engines and fuels. As a consequence they are able to plan such programs for economy of effort, execute them with a high degree of accuracy, and interpret the results in terms of their broad significance.

Cooperation with oil companies in knock rating studies on the road is just one of Ethyl's services to refiners in the evaluation of fuels, lubricants and engines. Ethyl's research and service program is designed to contribute substantially to the programs of oil companies which have as their objective the development of satisfactory and economical fuels and lubricants for today's and tomorrow's engines.

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VOLUME 3
NUMBER 5
MAY, 1948
PUBLISHED
MONTHLY

PETROLEUM PROCESSING

OTHER PLATT PUBLICATIONS:
NATIONAL PETROLEUM NEWS
OILGRAM NEWS
OILGRAM PRICES
PLATT'S OIL PRICE HANDBOOK

Covering the Management, Design, Operation, Equipment, Products of Plants Processing Crude Oil and Natural Gas into Fuels, Lubricants, Chemicals

Contents

for May, 1948

SYNTHETICS	Oil, Gas Only Volume Source of Liquid Fuels for Many Years	403
	Require Severe Treating Methods for Oils Extracted from Shale	404
	Appraisal of Gas Synthesis Operations *by R. C. Alden and Alfred Clark*	425
DESIGN	Basis for the Design of Instrumentation for Automatic Control of Liquid Level, *by Harold E. McClatchey*	451*
EQUIPMENT	Special Preview Section of the International Petroleum Exposition	457*
	Plant Practices—Practical Tips and Ideas	415*
	Laboratory Still Features Two Safety Devices for Handling Atmospheric or Vacuum Operations	418*
	Insulated Joint Performs Favorably at Temperatures Well Over 950 F. *(Equipment Patent Review)*	506*
RESEARCH	Modern Research Uses Wide Variety of Test Equipment	408
OPERATION	The Effects of Acid and Alkaline Wastes and General Methods for their Disposal, *by W. B. Hart*	409*
	Liquid Bromine Removes Obstinate Algae from 10,000 gpm Tower for $2.10/day, *by John C. Albright*	421*
	Regeneration Steps Cut Cost of Removing Mercaptans	435*
	Instrumentation of an Alkylation Unit, *by Harry F. Moore and George W. Gross*	441
MAINTENANCE	Coupling Allows Welding Pipe in Service, Saves up to 24 Hours in Repair Time	406
SAFETY	Color Coding Keeps Loading Safe at Utopia's Truck and Car Racks, *by Frank J. Sluze*	431*
MANAGEMENT	Had a Hand in the First Recovery of Liquid "Gas"—Col. George A. Burrell	405
DEPARTMENTS	What's Happening	393*
	Tomorrow in Petroleum Technology	397*
	Patent Trends in Petroleum Refining, *by Peter J. Gaylor*	449*
	What's New! Equipment, Materials, Processes, Literature	497
	Meetings for the Oil Man	509
	New Books for the Oil Man	508
	Petroleum Technologists in the Headlines	510
	Advertisers' Index	511
	Editorial Viewpoints	512*

COVER STORY

*** Indicates Exclusive in PETROLEUM PROCESSING**

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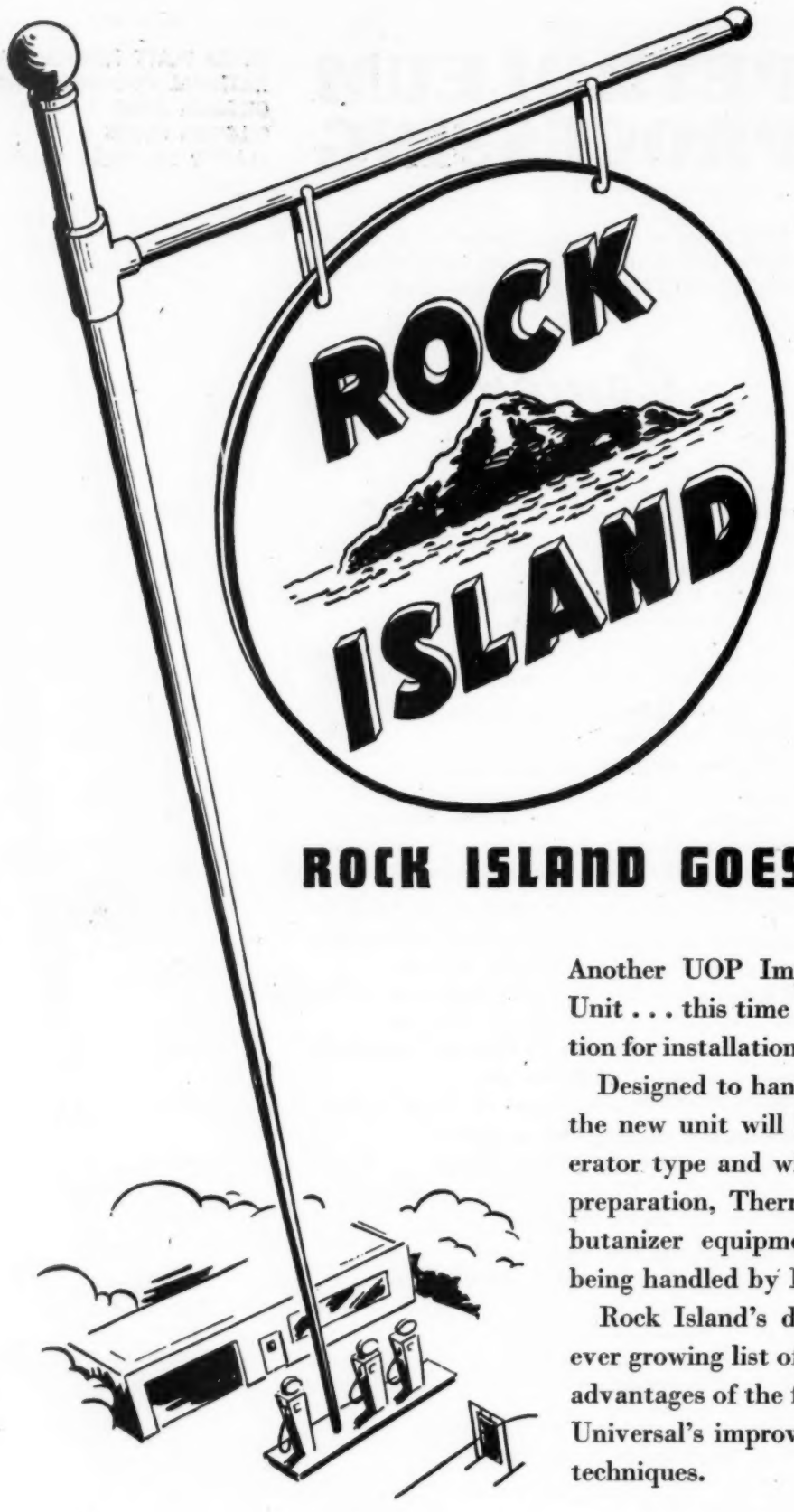
Published the first Tuesday of each month by The National Petroleum Publishing Co., 1213 West 3rd St., Cleveland 13, Ohio. Subscriptions: $3.00 a year in United States and possessions, $3.50 a year elsewhere. Single copies, 35 cents each; back copies more than three months old, 50 cents each. Published prior to Sept., 1946, as the Technical Section of National Petroleum News, devoted to REFINERY MANAGEMENT and PETROLEUM CHEMICAL TECHNOLOGY and including International Petroleum Technology. Trade mark registered U. S. Patent Office. Copyright 1948 by The National Petroleum Publishing Co. Acceptance under the act of June 5, 1934, at Cleveland, Ohio, authorized Jan. 15, 1948.



ROCK ISLAND GOES Fluid*

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Unit . . . this time for Rock Island Refining Corp
tion for installation at their refinery near Indianap

Designed to handle 5,000 barrels of gas oil per
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butanizer equipment. Procurement of materia
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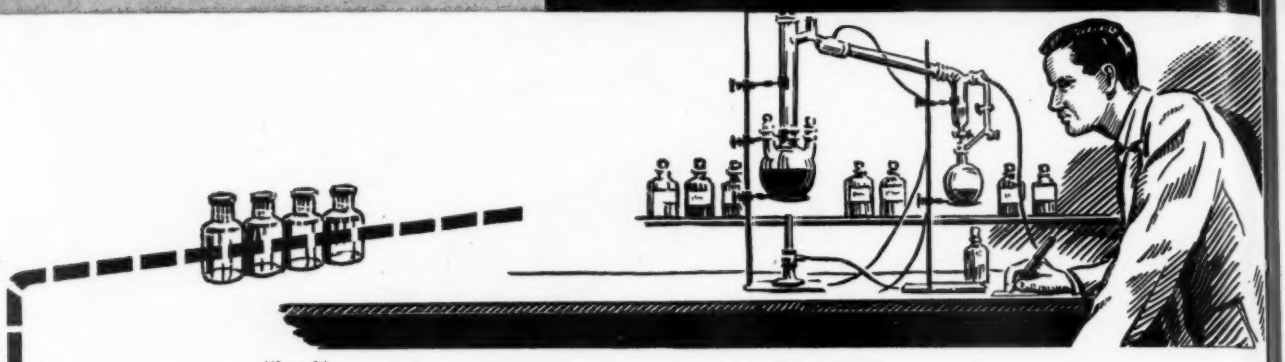
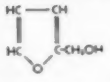
4 Furans YOU SHOULD KNOW

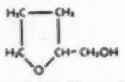


Furfural,

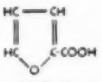
the cheapest pure aldehyde available today, is an amber colored liquid of high stability and purity. Use of furfural as a selective solvent continues to grow in refining lube oils, in processing other petroleum fractions such as gas oil, and in the solvent extraction of glyceride oils. For years it has been used for extraction of detrimental color bodies from wood rosin and more recently it was adopted for the extractive distillation of butadiene. Safety, stability, simplicity of the process, ease of recovery, and good yields of quality products are factors which have influenced this trend to furfural. It is also used as a chemical intermediate, wetting agent, ingredient of plastics, and general solvent.

Furfuryl Alcohol, 

a yellow to dark amber liquid, is an excellent solvent for nitrocellulose, dyes, synthetic and natural resins, and many other organic materials. It is miscible with alcohol, chloroform, ether, coal tar solvents and most other non-paraffinic solvents. The hydrogen atom in the 5-position is very reactive in acidic medium, a factor which complicates many of the ordinary alcohol reactions. Basic substances decrease the lability of this hydrogen atom. A number of important uses are based on the ready resinification of furfuryl alcohol, catalyzed by acidic reagents. The recently reduced price is now in effect.

Tetrahydrofurfuryl Alcohol, 

is a water white to pale yellow mobile liquid. It is a dispersant for chlorinated rubber, vinyl resin, nitrocellulose, shellac, rosin and ester gum, and is miscible with linseed, and blown soya oil, water and most organic solvents. It is an excellent dye solvent. Tetrahydrofurfuryl Alcohol undergoes the usual reactions of a primary alcohol. The ring exhibits the expected characteristics of a saturated, cyclic ether.

Furoic Acid, 

a white solid, is one of the newest available Furan compounds and is notably stable. It is soluble in hot water, in alcohol and ether, sparingly soluble in cold water, and insoluble in paraffinic hydrocarbons. Furoic acid enters into a wide variety of reactions; ask for Tech. Bulletin 101A. Product available at present in semi-commercial quantities.

BULLETIN 201–General Information about Furfural–is of interest to all users of chemicals.

BULLETIN 202–Introduction to the Chemistry of the Furans–contains information of interest primarily to the research worker.

Copies of either or both will be sent when requested on your business letterhead.

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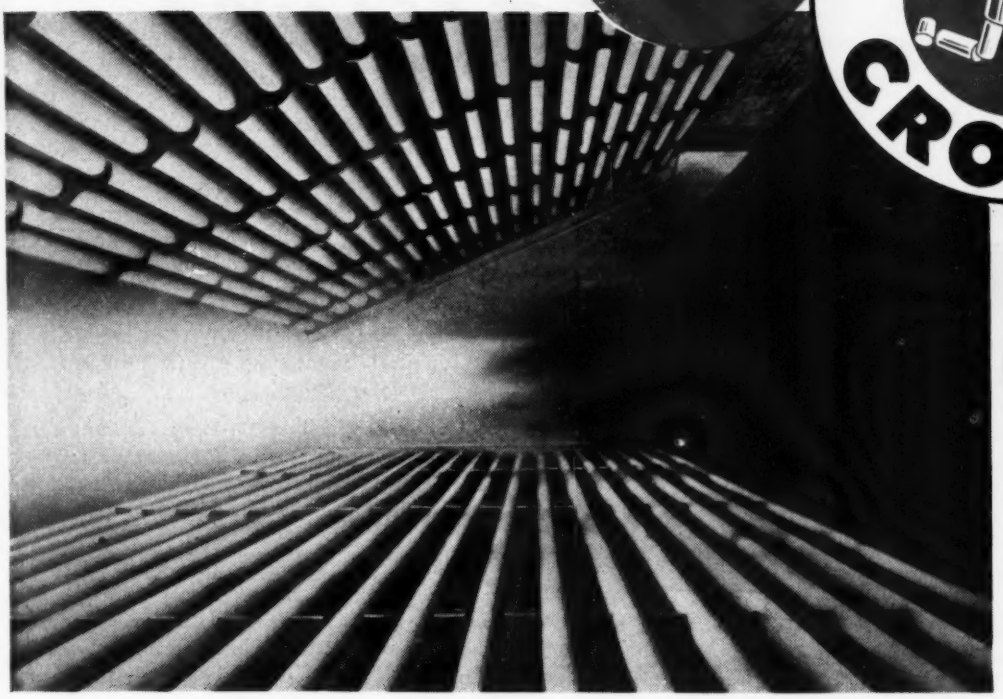
CALL ON CROLOY 7 *the economy tubing*



REMARKABLE ability to withstand corrosive attacks and oxidation from hot oils and chemicals resulting in fewer shutdowns for re-tubing — longer tube life — lower maintenance—have made B&W Croloy 7 widely known among refineries as the "economy tubing".

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Technical data on the properties of Croloy 7 are available for the asking. *"Call on Croloy"* any time you have a job for alloy tubing, for B&W Croloys embrace the widest choice of analyses available from a single source for refinery uses.

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What's Happening!

MAY 1
1948

Summary of Current News Developments Concerning Oil Men

SYNTHETICS

The legislation (H. R. 5475) aimed at fostering the development of a synthetic liquid fuels industry in the U. S. by providing for test plants of up to 30,000 b/d capacity is again being revised. The author, Rep. Wolverton of New Jersey, said his bill is being rewritten to further encourage the building of the test plants by private industry. The government would be empowered to lend financial encouragement and to afford anti-trust protection should this be considered necessary.

If, after a year, industry has not gone ahead on the program, the government could step in and build the plants. The revised bill, not yet introduced, does not stipulate processes to be used but like the previous draft gives Interior Department final say on processes, raw materials and plant locations.

Large scale production of oil from shale is uneconomic with the present price structure and availability of petroleum, President Reese H. Taylor of Union Oil Co. of California brought out in his annual report. He said his company holds 20,000 acres of oil shale in Colorado, containing an estimated 2 billion bbls. of oil. Union Oil is installing a 50-ton per day pilot plant for shale retorting which it is believed will provide the most economical means for extracting oil from shale.

To encourage private investments in synthetic liquid fuels plants, legislation has been introduced in Congress authorizing tax amortization of such investments over five years and permitting 27.5% depletion allowance on coal and oil shale used.

Cost of a 2,000,000 b/d synthetic liquid fuels industry as proposed by Interior Secretary Krug has been challenged by various industry authorities. A. L. Solliday, executive vice-president, Stanolind Oil & Gas Co., stated such a program would cost between $20 and $30 billion, instead of $9 billion. Dr. Gustav Egloff, Universal Oil Products Co., chairman of the Petroleum Division of the American Chemical Society, told the Society that to make 2,000,000 b/d of liquid products from coal and shale would cost $20 to $30 billion, and would take more than 16,000,000 tons of steel.

Dr. W. C. Schroeder, chief of the Interior Department's synthetic liquid Fuels research program, said cost of the program, if coal were the raw material, would be up to $20 billion and take about 13,000,000 tons of steel; if from shale it would be up to $4 to $5 billion and take 5,000,000 tons of steel.

President Truman has asked Congress to appropriate $1,500,000 for a survey by Army engineers to determine sites for commercial synthetic liquid fuels plants. Primary factors are sufficient coal and water.

• • •

LEGISLATION

A "compromise" Rizley-Moore bill to define the authority of the Federal Power Commission to regulate prices to producers for natural gas later moving into interstate commerce, has been voted out by the Senate Judiciary Subcommittee and is to be presented to the full committee. This is the first action on this measure in this session of Congress. As reworked the bill would exclude natural gas production and gathering facilities (in which is included gas processing) from federal jurisdiction.

New National Science Foundation legislation has been introduced in Congress, designed to comply with the White House views by providing for the appointment by the President of the Director of the Foundation. Veto of the previous science foundation bill was based on provision giving the Foundation board authority to appoint the director.

• • •

CONSTRUCTION, EXPANSION

Shell Oil Co. Inc. plans for a new refinery in New Jersey costing perhaps $100,000,000 came to light through discussions with groups in Woodbridge and Carteret townships on changes in zoning laws. Refinery would employ about 2000 people, it was said.

California Refining Co., 55% owned subsidiary of Standard Oil Co. of California, will expand its 15,000 b/d refinery at Perth Amboy, N. J., at cost of about $25,000,000.

Skelly Oil Co. will install a 30,000-bbl. crude distillation unit and catalytic cracking plant at its El Dorado, Kans., refinery. Crude unit will replace existing 25,000-bbl. facilities and the cracking plant will augment present thermal cracking facilities to provide complete 30,000 b/d capacity.

Phillips Petroleum Co. is planning a plant expansion program, to include one or two chemical plants on the Houston Ship Channel; a gasoline extraction plant in the Chocolate Bayou field, Brazoria county; a housing project at Sweeny; and 165-mile crude line from Corpus Christi to the company's Old Ocean refinery. Construction of the chemical plants hinges

Information on these pages is obtained through the nation-wide news coverage services of PLATT'S OILGRAM NEWS

on acquisition of ammonia plant in the Texas Panhandle on which the company has bid.

Creole Petroleum Corp.'s changes in design for new 60,000 b/d refinery under construction on the Paranguana Peninsula in Venezuela will increase gasoline output one-third and Diesel and bunker oil output by two-thirds. A 7000 b/d hydroforming unit will replace the 43,000 b/d fluid catalytic cracking unit originally planned.

• • •

RESEARCH

Standard Oil Co. (New Jersey) spent $18,000,000 in research in 1947, an increase of about 18% over 1946, company annual report shows. Large portion of the work was in conversion of natural gas to liquid products. Research facilities have been expanded through completion of a laboratory in Baton Rouge, enlarging laboratories of Carter Oil Co. at Tulsa and construction of a new laboratory at Linden, N. J.

Standard Oil Co. (Indiana) April 15-16 dedicated the first buildings of its new research laboratory on a 28-acre site near the Whiting refinery, with 500 leaders in industry, science and education from all parts of the country attending.

Stanolind Oil & Gas Co. has contributed $125,000 and Carter Oil Co. $100,000 towards completion of the $750,000 Petroleum Science Bldg. of the University of Tulsa.

• • •

PROCESSING

Development of a silica-magnesia catalyst for catalytic cracking was announced by technologists of the Esso Standard Oil Co., Louisiana Division, at the April 19th meeting in Chicago of the American Chemical Society's Division of Petroleum Chemistry. The new material is said to produce up to 25% more gasoline from crude oil than the silica alumina and clay catalysts now in commercial use. It is also claimed to have better activity maintenance and to give lower yields of C_3 and lighter hydrocarbons. Gasoline produced with it, however, is lower in volatility and in octane numbers by 2 to 3 points.

• • •

SUPPLY AND DEMAND

The oil industry will be able to meet an increase in demand of 4-5% over the 12 months through March 31, 1949, without resorting to the various distribution expedients used this past year, the Short Term Supply Committee of the API has reported.

Total supply available for domestic demand is placed at 6,025,000 b/d, about 8% (445,000 b/d) more than demand the previous 12 months. However, part of the increase must go to improve product stocks working levels, or distribution difficulties may be encountered. Net imports of 102,000 b/d are included in the supply figure.

Estimated average domestic production (crude oil, natural gasoline, condensates etc.) for 1948 is 5,865,000 b/d. This is 7.6% greater than in 1947 and 44% greater than the peak prewar year of 1941. Estimated average crude runs to stills for 1948, 5,482,000 b/d, are 8% greater than actual average crude runs in 1947 and 42% greater than runs in 1941.

The Bureau of Mines, in a revised estimate of 1948 supply and demand, estimated total demand at 6,230,000 b/d. It estimated average production at 5,870,000 b/d and runs to stills at 5,490,000 b/d.

Upwards of 1,000,000 b/d net imports of crude will be needed by the U. S. by 1955, Sidney A. Swensrud, executive vice president, Gulf Oil Corp., predicts. South America can be expected to supply not more than half this amount and the rest will have to come from the Middle East. To maintain the present level of crude production in this country, about 2 billion barrels of new discoveries a year must be made.

• • •

FOREIGN

Cities Service Co. and Petroleos Mexicanos have contracted for the exploration and development by the latter of more than 1,000,000 acres of oil lands in northeastern Mexico, the capital to be provided by Mexico-Cities Service Petroleum Corp., a subsidiary of the parent U. S. company. In the general Mexican expropriation proceedings an exception was made in the case of Cities Service concessions, which were held in status quo and the present contract is the result of negotiations concerning these properties.

The importance of developing the oil resources of the Middle East to relieve the drain on supplies in the Western Hemisphere is stressed in a statement by the board of directors of Standard Oil Co. (New Jersey). The statement said the company would continue to invest large sums to expand its oil holdings in the Middle East, but emphasized that policies governing trade relations there are political considerations and therefore our government's responsibility.

• • •

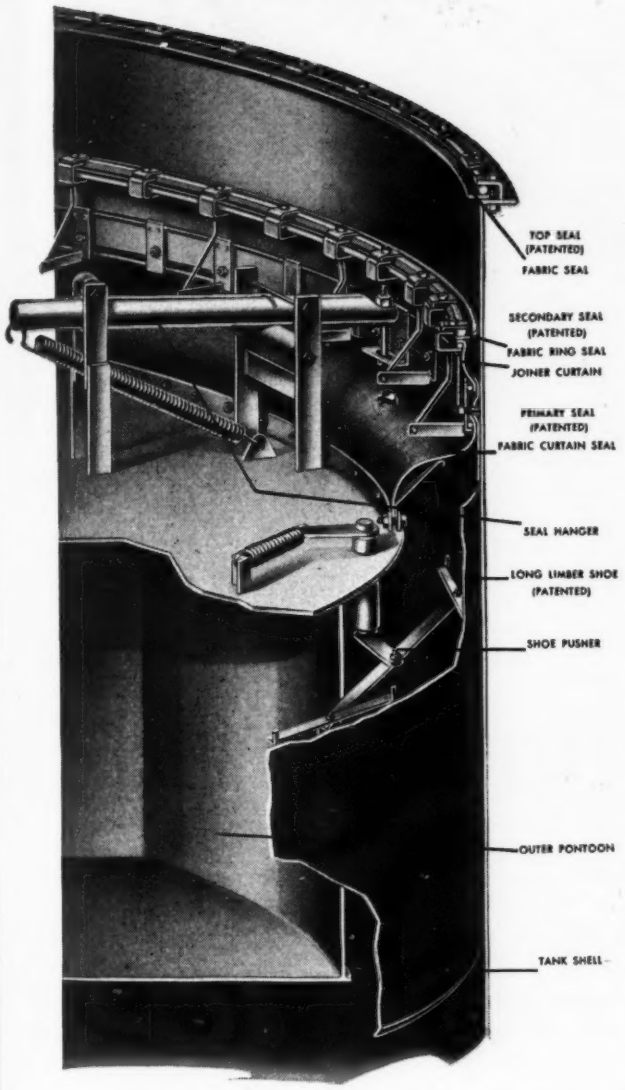
MISCELLANY

Ethyl Corp. April 19 notified U. S. and Canadian customers it is increasing price of ethyl fluid effective June 30. New price for motor mix will be 54.98c lb. (0.20 per c.c.) in place of present 49.482c lb. (0.18c per c.c.); aviation mix which now carries same price as motor mix, will be 60.478c lb. (0.22 per c. c.). Increased cost of lead, labor and freight caused the advance. E. I. du Pont at the time had made no decision regarding price of its tetraethyl lead compound.

Triple Protection

against

VAPOR LOSSES . . . LOSS OF QUALITY



Only the Wiggins Floating Roof Seal will trap the vapor between the outer pontoon and the tank shell and maintain this condition at all oil levels. This seal is divided into three component parts — the Primary Seal, the Secondary Seal, the Top Seal.

Briefly their functions are as follows:

THE PRIMARY SEAL, with its flexible metal shoe and vapor-proof curtain, maintains close sliding contact, regardless of any irregularities of the tank shell around its entire periphery.

THE SECONDARY SEAL, a neoprene coated fabric ring seal plus a joiner curtain, nullifies wind action and prevents pulsating. (Tests show that the standing loss is decreased, and the resultant saving is increased, by 50 percent or more through the use of the Secondary Seal.)

THE TOP SEAL prevents vapor losses when the float is within three feet of the tank top, at which point the Secondary Seal no longer functions.

For more complete information on how this Triple Seal Protection, plus many other exclusive Wiggins design features reduce evaporation and pumping losses, write for a copy of the Wiggins Hidek Floating Roof Bulletin.

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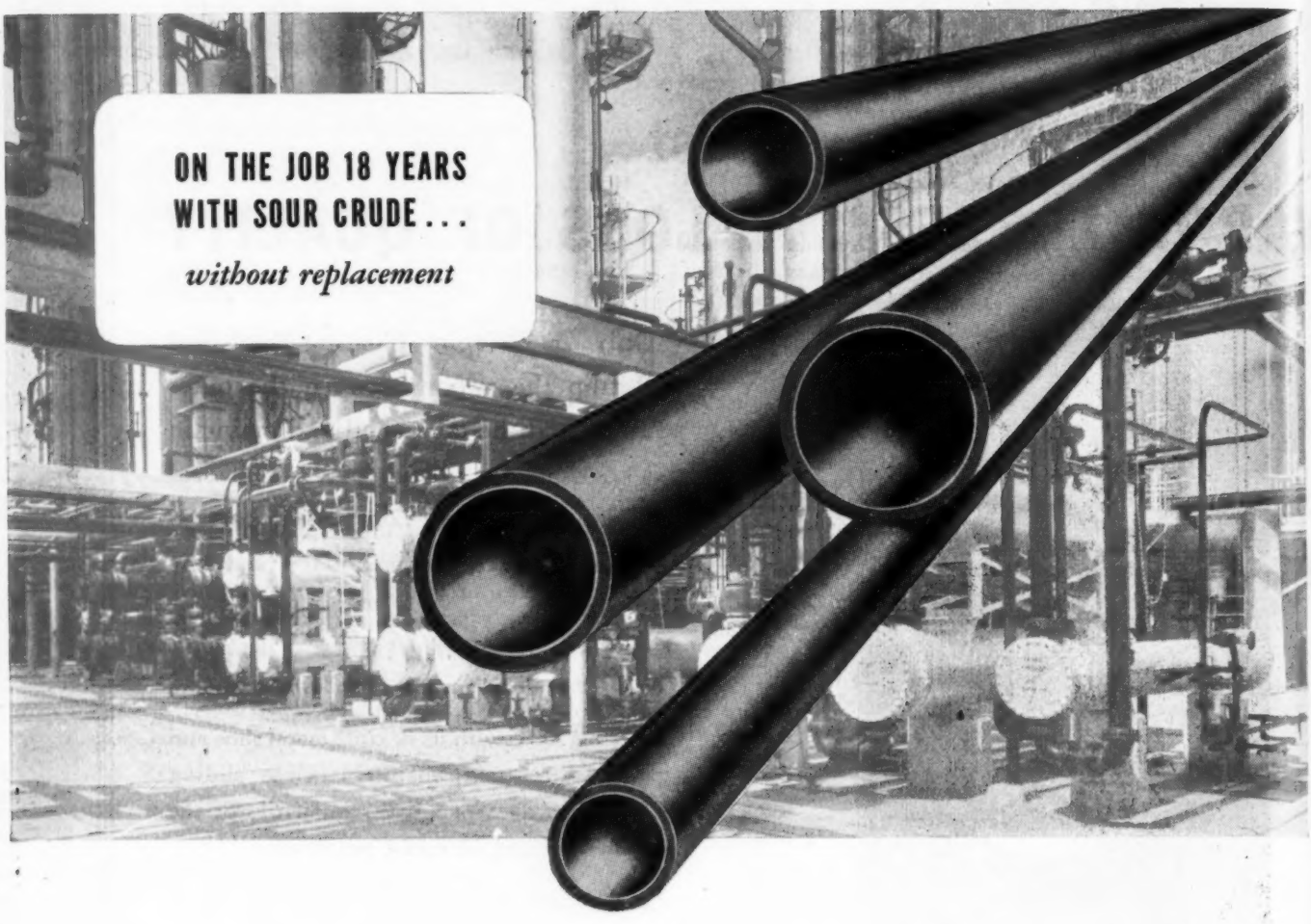

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TOMORROW

... IN PETROLEUM TECHNOLOGY

Current technological and economic developments discussed here in the light of their future bearing on petroleum refining operations include:

- **Oil re-refining assumes increasing importance.**
- **New light on government patent policies and practices.**
- **Refining industry active in acquisition of patents.**
- **Metal cutting basis of new unit process.**
- **Production of carbon blacks sets new record in 1947.**

Oil Re-refining Assumes Increasing Importance

IN THIS FEATURE series, the writer has on many occasions commented on the value, both to customer and producer, of the preparation of informational bulletins and releases Such publications serve a very real purpose by summarizing existing information in a usable manner, often even presenting data not previously available.

These remarks were brought home again to the writer when he recently looked through a bound volume of the 1947 issues of *Lubrication,* The Texas Co.'s "technical publication devoted to the selection and use of lubricants." This publication is familiar to almost everyone who has ever worked in the field of lubricants, and its monthly issues—each usually devoted to one subject only — are unique in that they sometimes constitute the only really good reference on some phase of lubrication technology—textile lubricants, for example.

In this particular (1947) volume, the subjects discussed are all of marked significance—automotive hydraulic transmissions; hydra-matic transmissions; inboard marine engines; low temperature engine deposits; flow properties of lubricating greases; lubrication of metals grinding machinery, portable air compressors, communications apparatus, and crawler tracks; lubrication in the meat packing industry and forging operation; and oil purification, filtration, and reclamation.

The issue on this last subject was of particular interest to the writer because it chanced that he was in the middle of compiling a literature search on this very phase of refining technology. This search is at present confidential, but certain phases of it are worthy of attention.

First of all, it may be somewhat surprising to note that well over 700 literature and patent references relate specifically to reclamation, or re-refining as it is sometimes called. How many more references exist remains to be determined later, incidentally, since only *Chemical Abstracts* has so far been consulted.

A second point of interest is the very large number of patents relating to the subject—about 500 of the 700 references located. Naturally, few of these are of major significance, but all contribute valuable information toward proper understanding of the art.

It is interesting to note that re-refining can also be used for other products than lubricants — cutting oils, metal cleaners, etc. Where these are highly compounded, however, successful purification may be difficult to achieve, since both "clay-type reclaimers" and "chemical treatment" remove most additives. This fact is also of considerable significance in regard to lubricating oils, since readdition of additives may be necessary for certain applications.

Business aspects of re-refining are more than interesting. In certain large cities, plants have been established for central collection and re-refining of oil, either (1) on a direct purchase basis (of used crankcase oil, etc., from filling stations, fleet operators, and other large users), for later resale, or (2) on a "service charge" basis, whereby the large user of oil pays a nominal fee for reprocessing (and avoids the necessity for paying tax on new lubricating oil). Much more common at present is the use of re-refining equipment by the large users themselves; plants come ready-built in a variety of sizes, and are not particularly difficult to operate.

Petroleum products are now both more costly and in heavy demand, and "conservation" is the watchword of the day. When such conservation makes good economic sense for immediate application, as it often does in the case of re-refining for large users of lubricants, there seems every reason to expect increased use of the methods involved. These need not be detailed here, because of the recent summary included in *Lubrication* (1), however, it is certainly necessary to add the cautionary note that re-refining must be thorough and adequate or damage to equipment will exceed monetary savings. When this is fully provided for, satisfactory service from re-refined products can usually be obtained.

New Light on Government Patent Policies, Practices

THE PETROLEUM INDUSTRY during the war contributed its inspired research efforts wholeheartedly to winning that conflict, and in so doing found itself working in close cooperation with many branches of the federal government, agencies engaged in research and operations in many fields. In conducting the research involved, petroleum companies at once became aware of vast confusion in the patent practices of the various agencies, especially since considerable political agitation was incited by those who felt that the patentable results of any research sponsored even in part by Government funds ought to be freely available to all.

Discussion of such political aspects is not pertinent here, except to note that the debate on this subject inspired the preparation of a three-volume "Report and Recommendations of the Attorney General to the President,"(2) which documents are of considerable interest over and above the debatable recommendations for a uniform Government patent policy contained in the first volume.

The second volume contains detailed and highly informative monographs on the patent practices and policies of the 14 Government departments and agencies most concerned with the problem. As is often the case with factual Government publications which need not deal with policy, these accounts are clear and logical (possibly even more so than the actual case, for some departments), and ought to be of considerable value to companies with present or potential Government contracts.

Volume III is of by far the greatest general interest. Prepared to give

(1) Anon., "Oil Purification, Filtration and Reclamation," *Lubrication* 33, No. 1, 1-12 (1947).

(2) Anon., *Investigation of Government Patent Practices and Policies. Volume I. Final Report Proper; Volume II. Monographs on Governmental Departments and Agencies; Volume III. Monographs on Nongovernmental Organizations, Foreign Countries, Legal and Historical Studies, and Bibliography.* U. S. Department of Justice, U. S. Government Printing Office, Washington, D. C., 1948.

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429 DAYS

THE on-stream records of the three Cities Service Fluid "Cats" illustrated here, prove the Kellogg thesis that the foundation for earning power in refining units is the engineering "know how" that is built into them. Conversely, the best designed unit in the world cannot attain its maximum earning power without the utmost care and efficiency on the part of the operators.

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the Government background information on the patent relationships between other employers and their inventive employees, it contains descriptions of the patent policies of 17 private research organizations (such as the Mellon Institute, Armour Research Foundation, the API, the American Chemical Society, etc.), 40 educational institutions (such as MIT, Georgia Tech, Purdue, various state universities, etc.), 10 foreign countries, and a large number of private research laboratories.

Also included is a factual monograph on the principles of law applicable to the interest of the U.S. in inventions made by its employees and contractors, an interesting monograph on prior studies and legislative proposals, and a bibliography of 229 references on the general subject of patent relations of employers and employees.

It would obviously be futile to comment here in detail on the contents of the more-than-1000 pages contained in these volumes. It goes almost without saying, however, that these books are a "must" for the libraries of any companies planning to engage, or already engaged, in research for or with Government agencies. Patent rights are a matter of great importance so long as a competitive economy continues to exist in this country, and every company owes it to its stockholders not to surrender what belongs to it just because the work performed has an altruistic and patriotic, rather than a profit, motive.

On the other hand, the patent system was created for the eventual benefit of the public, not the inventor —to whom only limited rights are given—so an unthinking obstinacy is equally unfair.

Refining Industry Active in Acquisition of Patents

WHILE ON THE subject of patents, it might be interesting to note a few statistics on the 1947 patents "of interest" to the refining research division of one of the major petroleum companies. According to an internal report of the patent section of this research group, some 1032 of the 20,279 patents issued in the U. S. in 1947 fell in this "interest" category—slightly over 5% of the total.

This patent group included 23 patents issued in 1946 in the abstracts it prepared in 1947, so its further breakdown is based on 1055 patents. Of these, 159 were concerned with "products"—96 with "lubricating oil additives"; 72 dealt with "special products," of which 49 related to "insecticides"; 218 patents were concerned with "synthesis" (61 with alkylation, 55 with isomerization, and 32 with polymerization); 181 with "auxiliary materials" (76 with catalysts); 135 with "cracking" (110 with catalytic cracking); and 49 with "physical treatment," of which 22 related to "solvent extraction."

Of the 1032 patents issued in 1947, 650 were granted to the 11 companies which received at least 21 patents in that year. These companies include the Standard Oil Development Co. (145), Phillips Petroleum Co. (109), Shell Development Co. (83), Universal Oil Products Co. (78), Socony-Vacuum Oil Co. (69), Standard Oil Co. of Indiana (44), and five companies receiving 21-29 patents each — The Texas Co., du Pont, Pure Oil Co., the Gulf Companies, and the Union Oil Co. of California.

No further breakdown is warranted here, and it must be remembered that these figures are qualified—they do not represent all the patents granted to these companies, but instead only those deemed of interest to petroleum refining. Furthermore, the patents themselves show the usual concentration on processes and products of predominant interest at the time of application (anywhere from three to five years ago, on the average, since patents now take that long to clear the overburdened Patent Office); were it possible to get such a statistical review of patents *applied for* in 1947, a far more significant picture could be obtained.

Metal Cutting Basis Of New Unit Process

PETROLEUM REFINERS have long been interested in such machine shop operations as metal cutting and have devoted considerable research efforts to the development of improved cutting oils, by now an established "petroleum specialty." Such oils have been found to serve at least two purposes when in use—cooling and lubricating—and research is continuously under way in an effort to understand exact mechanisms, so that new cutting oils may be developed.

A report on a new development in this field, while not directly pertinent to petroleum refiners, notes that "during a study of the basic mechanism of cutting-fluid action, it was found that certain organic reagents when used as cutting fluids react vigorously with the metal cut even though these same chemicals were relatively inert to the uncut metal in bulk.(1)

This observation has led to research on the reaction of gases and liquids with the metals being cut, and "subsequent tests showed that a metal-cutting process could be used to advantage in starting and controlling certain reactions involving metals. In several cases the metal was consumed as rapidly as it was cut . . . . Metal involved in the preparation is cut in the presence of the other reactants, thus utilizing the high temperature, high pressure, and highly stressed nascent surface produced at the point of cutting to start the reaction."

Organometallic compounds produced by such reactions will probably become of increased commercial significance, since they can thus be produced continuously in a controlled manner. This unit process is another contribution to science which has resulted from petroleum-related research.

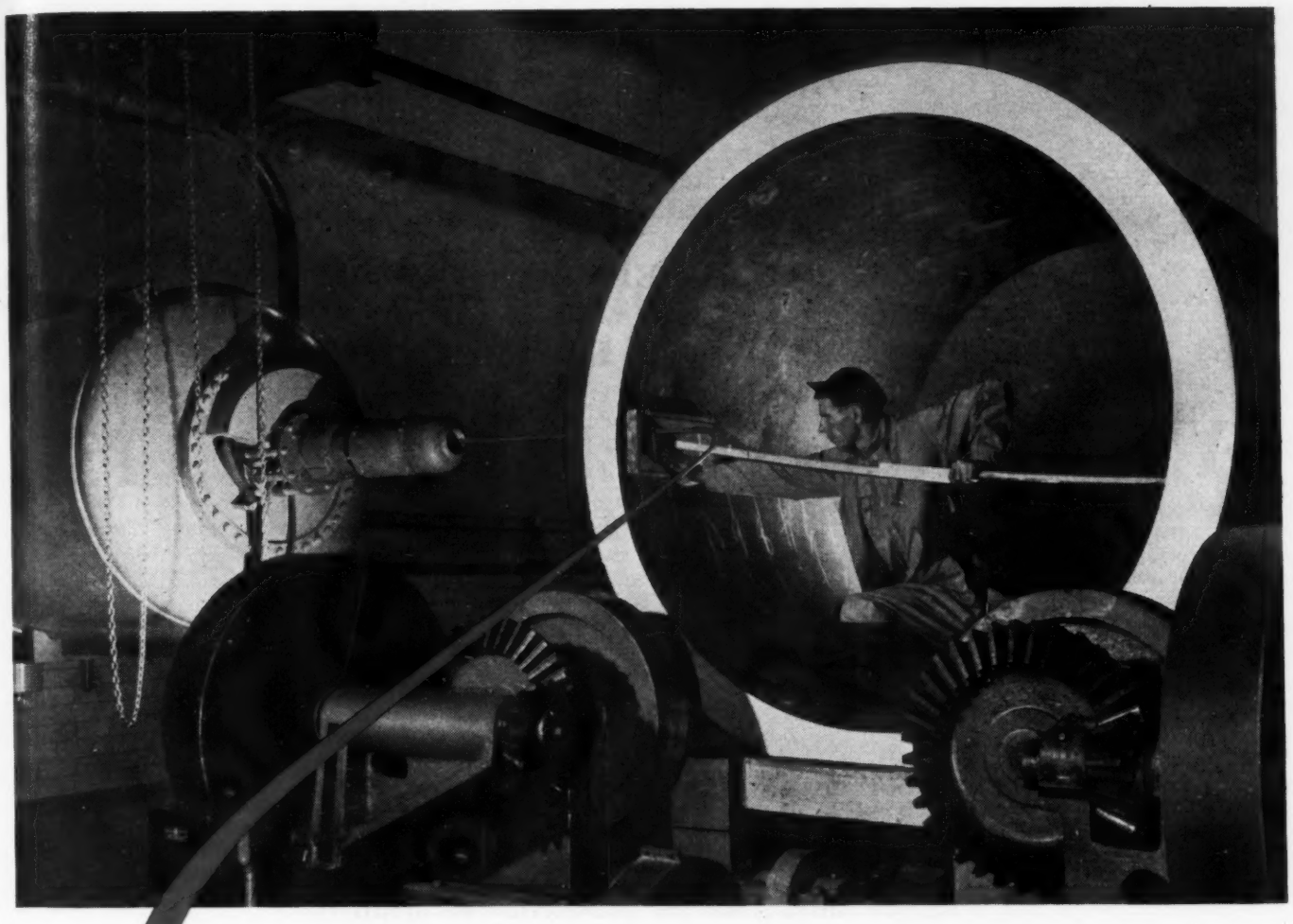
(1) Shaw, M. C., "Metal-Cutting—A New Unit Process," *Chemical Engineering* 55, No. 2, 264, 266 (1948).

Production of Carbon Sets Record in 1947

ACCORDING TO RECENT Bureau of Mines' statistics, 1947 production of carbon blacks totaled 1,318,474,000 lbs.—645,128,000 lbs. of channel blacks and 664,346,000 lbs. of furnace blacks, compared with 1946 figures of 1,244,421,000 lbs. (total production), 619,109,000 lbs. (channel blacks), and 625,312,000 lbs (furnace blacks). Consumption more than kept pace with production, total stocks at the end of 1947 being 72,404,000 lbs. (of which only 6,956,000 lbs. were channel blacks) as compared with 76,228,000 lbs. at the end of 1946 (17,006,000 lbs. the channel varieties). According to the figures released, exports in 1947 totaled 319,076,000 lbs, as against 271,085,000 lbs. in the previous year.

These figures are startling indeed when compared with gloomy wartime predictions that the carbon black industry would find itself tremendously overexpanded as soon as hostilities ended. It is true, of course, that the "final returns" are not yet all in. This and succeeding years may witness a lowering in demands, as rubber products fill and overflow the pipe lines of commerce. Exports may conceivably fall of if free trade becomes more difficult in a world divided into two ideological camps and further complicated by financial barriers; furthermore, production abroad may reach a significant scale.

Finally, the rising cost of natural gas and petroleum fractions will have an inevitable effect on the price of carbon blacks produced therefrom, and higher prices may mean lessened usage. However, it is by no means certain that all of these will happen, and those depressing factors which do come into play may be compensated for by other influences.



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McKEE IS ACTIVELY ENGAGED IN THE PROGRAM FOR PRODUCTION OF

SYNTHETIC PETROLEUM PRODUCTS

Two important government agencies have recommended a program requiring the expenditure of 8 to 9 billion dollars for the production of synthetic petroleum products.

While this goal may not be attained in the foreseeable future, we consider it significant of the importance of synthetics to the petroleum industry.

The McKee organization is now engaged in the engineering and construction of one of the first synthetic gasoline plants in America.

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MAY, 1948

Oil, Gas Only Volume Source Of Liquid Fuels for Many Years

AFTER looking at the program I think maybe we will have to change the name of this organization to the 'Western Synthetic Liquid Fuels Assn.'"

So said the chairman of the opening session of the 36th annual meeting of the Western Petroleum Refiners Assn., in Galveston, April 5-7. He was referring to the papers to be given on various phases of synthetic liquid fuels manufacture.

After the papers had been duly presented, and the ensuing discussion recorded, the chairman of the final session said in his concluding remarks, with a definite note of relief in his voice:

"I guess we can keep on using the WPRA insignia after all. It looks like they are going to need our refineries for a long time to come."

Thus was epitomized the trend of thought throughout this meeting. The nation's entire dependence on liquid fuels in volume must remain with petroleum, and natural gas, for a great many years to come. The processes using other materials, such as coal and oil shale, must be developed in an orderly fashion over a long period of years, so that the necessary capital, materials and technological manpower will be available when required.

Would Affect Economy

To plunge ahead now full scale into a synthetic fuels program might seriously affect our general industrial economy and still not insure that the nation is provided with fuels in anywhere near the volumes required, it was brought out. For example, to build plants to make 650,000 barrels daily of liquid products from coal would require nearly 10% of the nation"s annual steel output.

R. C. Alden, Director of Research, Phillips Petroleum Co., Bartlesville, Okla., sized up for the WPRA the extent of our petroleum reserves as sources for liquid fuels, and in particular appraised natural gas reserves for this utilization. He included natural gas with crude oil as petroleum in view of the fact that technological improvements of recent years now make gas synthesis operations an economic source of liquid fuels.

In view of our potential petroleum reserves, including both crude oil and natural gas, we should be thinking of 60 to 200 years, instead of 13 years, as the period when we will really have exhausted our petroleum, he stated.

"Blue Chip" Inventories

"Every one knows that our so-called petroleum reserves are 'blue chip' inventories rather than speculative potentialities," said Mr. Alden. "Thus, for every barrel of crude oil produced or producible, there are probably one to two barrels of 'unrecoverable' oil. It is entirely reasonable to anticipate that future improvements in production methods, the further application of the more modern production methods and a more favorable price situation will put more and more of this 'unrecoverable' oil into the 'known crude oil reserves.'

"Few are bold enough to predict how much more crude oil will be added to our reserves stockpiles by the discovery of new deposits but the most optimistic are of the opinion this may be two times as much as already discovered. We cannot be so optimistic. Nevertheless, we can conclude that our potential petroleum reserves are at least 5 times as great as would be concluded from our 'known reserves' and may be almost 15 times as great."

In appraising natural gas alone as a source for synthetic liquid fuels Dr. Alden said that, barring a tremendous increase in the rate of discovery of new gas reserves in the U. S., it cannot be considered a long-range supply. However, developments to date indicate it will play an important "transition" role in the development of a synthetic liquid fuel industry, regardless as to whether coal or some other carbonaceous material serves as the ultimate long-range source.

Assumption of large new gas discoveries and of a waning rate of increase in the already established uses for natural gas would lead to the conclusion that large gas synthesis operations could be maintained. At the other extreme, waning discoveries and accelerated uses in established markets would make it difficult to maintain any volume of gas synthesis operations.

Limited Geographically

Another limiting factor, the speaker brought out, is that synthesis plants will be limited to regions where sufficient gas reserves are available. He said that approximately one half trillion cubic feet of gas is required to operate one 7000-barrel daily plant for 20 years. Since, at the present time, the gas synthesis process cannot economically stand the expense of a long distance gas gathering system, a further restriction is placed upon the installation of commercial plants in that they must be located near their gas supplies.

"Future gas synthesis operations up to several hundred thousand barrels per day could be sustained by our natural gas resources", stated Mr. Alden, "provided (a) that the operation can compete economically with the processing of crude oil and (b) can pay a price sufficiently high for natural gas to stimulate new discoveries."

Two technological improvements in this country on the original German Fischer-Tropsch water gas synthesis, it was brought out, have made it possible to undertake commercial scale natural gas synthesis. The

Gas-Synthesis Paper

The complete text of the paper, "Appraisal of Gas Synthesis Operations" presented before the W.P.R.A. meeting by R. C. Alden Director of Research, Phillips Petroleum Co., is published in this issue, starting on pg. 425. Alfred Clark, Supervisor, Research Department, is co-author of the paper.

first is the manufacture of the synthesis gas by partial oxidation of natural gas at high temperatures with relatively pure oxygen. This partial combustion of natural gas with oxygen is described as an extremely rapid reaction requiring far less equipment than when coal is the raw material as in the conventional water gas sets employed by the Germans.

"The installations for producing oxygen will be much larger than any previous installations and will incorporate many improvements made possible by large scale application and in part developed during the war," Mr. Alden stated. "The cost of this oxygen will be considerably less than any previous costs and the exact cost is still a subject of considerable engineering analysis."

In considering other sources for synthetic liquid fuels, such as coal, Mr. Alden brought out that a significant consideration is that such substitute fuels require more energy for their reduction to useful products than do crude oil and natural gas. According to our present technologies, he said, a fair average is that more than 50% of the energy of the substitute fuels is required to reduce them to liquid products possessing suitable form and place utility. This in itself is a material expenditure of these resources and only to be undertaken when there is a compelling reason.

Plant cost for the conversion of coal into synthetic liquid products was given by Mr. Alden as approximately $8000 per daily barrel of production. Using natural gas, costs are variously estimated at $3000 to $4000 per barrel per day. In order to produce 650,000 barrels daily of product from coal, an investment of 5.2 billion dollars would be required, approximately twice that starting with natural gas.

To produce a barrel of oil from coal, from 8.7-12 tons of steel are required, as compared with around 3.2 tons to produce a barrel of oil from a new refinery in a new oil field, it was brought out. In order to produce 650,000 barrels daily of oil starting with coal, about 5.6-7.8 million tons of steel would be required, equivalent to 7.1-9.9% of our 1945 steel production.

The coal consumption for the production of 650,000 barrels daily of liquid fuels would be approximately 160 million tons a year, or about 28% of the 1945 figure for coal production in the U. S., which would require considerable extension of present coal mining facilities.

Require Severe Treating Methods For Oils Extracted from Shale

PRELIMINARY data on the processing and treating of oil extracted from shale was presented before the Western Petroleum Refiners Assn., at its Galveston meeting, by J. G. Tripp, chemical engineer at the U. S. Bureau of Mines Oil Shale Demonstration plant at Rifle, Col.

A 200-barrel a day refinery is now under construction at Rifle, he said, where various methods of processing shale oil and its fractions can be studied, as well as methods for treating products to remove the sulfur and nitrogen compounds present.

The refining plant consists of a single-coil tube still designed for atmospheric distillation, viscosity breaking, thermal cracking and reforming operations. The unit also includes two coking chambers, one of which is designed for service as a reaction chamber on recycle cracking operations; also a flash fractionator and stabilizer and absorber. A treating plant being built in connection with the demonstration refinery consists of a continuous three-stage, low temperature, acid treating unit, rerun column and continuous doctor sweetening unit.

The work to date at the Bureau's shale oil plant, said Mr. Tripp, indicates that mild catalytic hydrogenation is a more promising method for reducing sulfur and nitrogen contents of the cracked gasoline recovered from shale oil than is chemical treating. At the present stage of development it is found that catalytic hydrogenation also hydrogenates some of the olefins present in the gasoline, thus reducing its octane value. Mild catalytic hydrogenation of the crude oil extracted from the shale is being investigated as a means of decreasing the sulfur and nitrogen content and also improving the raw stock in other ways.

The so-called oil shale is actually a grayish or brownish marlstone, said Mr. Tripp, and, contrary to general belief, is not impregnated with oil but contains an organic material known as "kerogen". The kerogen is only slightly affected by solvent action at normal temperatures but, upon destructive distillation, yields oil, gas and fixed carbon.

Part of the sulfur and nitrogen compounds which exist in the shales are recovered during the extraction operation and are to be found in the raw shale oil. While these compounds may present difficulties in their removal, the nitrogen compounds in particular may have possible value as by-products. Magnesium and calcium is present in the shale in the form of carbonates which decompose upon heating and may present problems in the extraction process.

The raw oil extracted from the shale is a black, viscous, waxy material with properties which are distinct from those in crude petroleum. A distinguishing feature of the oil from shale is said to be a high olefin content, that of the naphtha fraction being approximately 50%. The high olefin content results in excessive formation of gum and resin in all fractions distilled from the crude. The nitrogen compounds which are found in the gasoline cracked from shale oil do not seem to interfere with the combustion characteristics of the product, it was reported. However, poor color stability and odor resulting from the nitrogen compounds may have an undesirable effect on the gasoline.

The sulfur content of the crude shale oil is not excessive as compared with some petroleum crudes. However, it is present largely in the form of thiophenic sulfur and may prove difficult to remove from distillates without degrading some of the desirable hydrocarbon components.

The shale oil crudes so far recovered in the Bureau of Mines experimental work are deficient in light ends, said Mr. Tripp, but he explained this deficiency might be at least in part due to the present extraction processes which are being used.

Straight fractionation of the raw shale oil does not give products that will meet specification of present petroleum products except in the case of residual fuel oils, Mr. Tripp stated. Around 10% of tar acids and tar bases are present in the straight-run naphtha cut from shale oil. The sulfur content of the crude shale oil which is being worked with at the Bureau's plant is around 0.86%.

Approximately 17% of the crude shale oil boils in the range of No. 1 burner fuel, and this can be processed to make specification material, it was reported, except that its high pour point and gum content may make it undesirable for Diesel fuel. About 40% of the crude boils in the range of No. 3 distillate fuel, having a pour point of around 435° F., which would have to be lowered to make a specification product.

The title of the paper presented before the WPRA by Mr. Tripp was "Oil Shale as a Source of Synthetic Liquid Fuels". Boyd Guthrie, chief of the Bureau of Mines oil shale demonstration plant at Rifle, collaborated with Mr. Tripp in its preparation.

COL. GEORGE A. BURRELL

Had a Hand in the First Recovery of 'Liquid Gas'

ALL the years of the natural gasoline industry are encompassed in the experience of the man who stood before the Natural Gasoline Assn. of America, March 25, at Fort Worth, to receive its prized Hanlon Award—Col. George A. Burrell, New York, president of Atlantic States Gas Co.

His wiry, erect figure and vigorous appearance belied the length of the period in which, as inventor, engineer and business executive, he has contributed to the technology and operating practices of the natural gasoline and allied liquefied petroleum gas industry.

The presentation of the award, made by NGAA president C. R. Williams, The Chicago Corp., Corpus Christi, referred to Colonel Burrell, among other scientific achievements, as being the first experimenter to make an exact analysis of natural gas. He conceived the type and character of equipment required, made and assembled it himself and made it work. This work "was one of the most important detail steps in the technological progress of the petroleum-gas field", said Mr. Williams.

Began With Mines Bureau

Graduating from Ohio State University in 1904 as a chemical engineer, Colonel Burrell went with the U. S. Bureau of Mines to study mine gases. His work soon broadened to include natural gas and, in 1911, together with Frank Peterson, then of Grove City, Pa., one of the pioneers in the LPG business in this country, he took an active part in experiments in West Virginia which led to the first separation and recovery of liquefied petroleum gases. His report to Bureau of Mines now a classic on this subject, is "Liquefied Products from Natural Gases, Their Properties and Uses".

The foundations of the compression process of extracting gasoline from natural gas were laid in this period. Also, in these years, Frank Peterson with A. N. Kerr, of Sistersville, W. Va., separated fractions of liquid from the gas streams of their plants that approximated the LPG of today, fractions in which propane and butane predominated.

These early studies by Colonel Burrell stimulated a desire to know more about the composition of natural gases and this led to the attempts to determine the characteristics of hydrocarbon gases. From this work resulted the development of apparatus to analyze gases mentioned in the Hanlon Award citation. Another Bureau of Mines report documented this accomplishment and led to the development of the method by Podbielniak and others for the examination of complex gas mixtures by low temperature analysis.

In the research field also, his work in 1915-16 on the compressibility of natural gas at high pressure laid the groundwork for the studies by Brown and Katz, at the University of Michigan, and others, which made available to industry the equilibrium constants and other important physical data on gases and hydrocarbon mixtures.

Fought Patent Claims

In 1916, working with others, Colonel Burrell designed and built a natural gasoline plant which was later alleged to be the first infringement on the then existing absorption patents. He fought these patent claims and appeared as an expert witness in the suit which eventually invalidated the patents and removed restraints from the natural gasoline industry.

In 1917, being then known internationally as an authority on gases, he was requested by the British government to find helium gas for the dirigibles being used in the first World War. He had already determined that a high nitrogen content in a natural gas usually indicated a high helium content. By repeated analyses of gases in the south and west he located a source of supply of helium in western Kansas and his report induced the U. S. government to appropriate funds for the extraction of helium for use by the British.

During World War I also, in research in offensive and defensive gas warfare, with rank of Colonel, he directed the largest group of scientists who had ever been gathered together for a single purpose up to that time. For this work Colonel Burrell was awarded the War Department's Distinguished Service Medal.

In 1921, in collaboration with other scientists, he aided in the development of the activated charcoal method for the extraction of natural gasoline, a method which gave greater volatility control than was previously obtainable. Although this method was soon outmoded by the advent of the plate-column type dephlegmator, it was recognized as a distinct advance in the technology of the natural gasoline industry.

Organized Engineering Service

During the '20s Colonel Burrell expanded his interests in the petroleum and gas industries and broadened his activities to include cracking and petroleum refining in general. He built his own engineering and service organization and began the development of equipment and supplies for use in both the natural gasoline and refining industries. He is now the active head of several companies he has organized and serves on the directorates of other companies.

Colonel Burrell was the 12th recipient of the Hanlon Award, which is conferred each year by the Natural Gasoline Assn. of America for outstanding service to the natural gasoline and cycling industries. Donor of the Award is E. I. Hanlon, president of the Hanlon Companies and chairman of the board of the National Bank of Tulsa.

Coupling Allows Welding Pipe in Service, Saves up to 24 Hours in Repair Time

A NEW coupling, designed to permit welding pipe while it is under pressure, and, preferably, while a stream of fluid is moving through it, is said to effect considerable savings in pipe repairs and maintenance.

With the coupling, worn sections can be replaced safely and the line returned to service 2 to 24 hours sooner than is possible with present conventional methods. Actual welding can then be done as long as several days, or even weeks later—after the line has been returned to active service.

The "Safety-Weld" coupling, as the new invention is called, is described in one of the prize-winning papers in the 1947 James F. Lincoln Arc Welding Foundation Awards, "The Safety-Weld Coupling", written by the inventor of the device, Mr. Joseph B. Smith, mechanical engineer, Transportation Department, Standard Oil Co. (Ohio).

The working principle of the coupling is illustrated in Fig. 1. As may be seen in the drawing, the coupling consists of a steel sleeve with internal grooves near each end. Neoprene packing rings, cut to fit the outside diameter of the pipe, fit into the internal grooves. One-eighth inch pipe connections permit a putty-like lubricant to be forced in behind the outer periphery of the packing rings.

This lubricant, using gun pressures up to 10,000 psi., squeezes the packing rings between pipe and coupling walls, and creates an effective leak-proof seal. Owing to the design of the coupling grooves and the stiff lubricant used, it is possible to disconnect the presure gun and insert a ⅛ inch pipe plug without appreciable loss of pressure from behind the packing rings.

The step-by-step procedure of repairing a line with the safety weld coupling is shown in the photographs, Figs. 2 through 5. In Fig. 2, the pipe has been cut and the coupling pushed over the end of the section on the right. The workman is scribing a mark on the section at the left at a distance from the end equal to one-half the length of the coupling. The small screw heads are in the openings through which the lubricant is to be applied.

In Fig. 3, the ends have been joined by moving the coupling back over the other section to the mark. The workman is now tightening down on the clamping bolts.

In Fig. 4, lubricant has already been forced into the coupling and the pipe has been returned to service. All openings as well as the ends of the coupling are being arc-welded. The line itself has been carrying its regular load for several days.

Fig. 5 illustrates the completed repair. The clamping bolts were removed following the application of the first stringer bead around the ends.

In comparing operations between the new coupling and conventional methods, Mr. Smith pointed out that several steps can be saved. For example:

1. It is not necessary to plug off the ends of the line with pipe fire clay or rubber plugs.

2. Careful cutting to exact length and precise beveling of pipe ends for butt welding is not necessary. Without using extreme care, the cut for length is made using a hacksaw or pipe cutters. If the pipe ends fail to meet by ½ or 2 inches, it does not matter, as the coupling will cover the difference. A cutting torch is not used for trimming and beveling with the safety-weld device.

3. Butt-welding of the pipe joint is eliminated.

4. Where the repairs are made following a bad leak, the earth would still be saturated with flammable hydrocarbons. The line, however, can be put into immediate operation, and several days or weeks may be allowed to elapse until evaporation has entirely removed the hazardous vapors before final welding.

In a case where a crude oil line carries 2000 bbls./hr. at a revenue of 10c/bbl. after deducting power costs for pumping, it would have cost the company $200/hr. for shut-down time, Mr. Smith stated.

Furthermore, "the safest condition for welding on a crude oil or a gasoline pipe line is with the line full and a stream moving through it at medium pressures, say not in excess of 300 or 400 psi.," he said. "It should be noted that these couplings have

Fig. 2—After pipe sections have been cut with pipe cutter, coupling is slipped over one end

Fig. 3—Clamping bolts are then tightened down preparatory to forcing stiff lubricant into coupling

been tested before the ends were welded with over 1000 psi. gasoline pressures without leaking a drop." It is understood the couplings are now being manufactured by the Clark-Goodman Supply Co., Cleveland.

As a means of calculating savings to be realized, Mr. Smith cited a hypothetical 8-inch pipe line 100 miles long and carrying crude oil.

"We will say that the line is 20 years old, so there are some badly corroded sections to be found. The replacement of corroded sections; the lowering of sections because of county drainage ditch improvements; the moving of sections because of new highways, reservoirs, and other public works; the installation of new gate valves; and the installation of insulating flanges all add together so that three sections are cut out each year in the 100 miles of pipe line. Each section cut out will require two rejoining butt welds or two 'Safety-weld' couplings.

"The line averages 24,000 b/d or 1000 bbls./hr. The gross revenue (after deducting pumping power costs) is 5c/bbl. The cost of shutting down the line would be $50/hr.

"The cost of labor and expenses for the maintenance crew consisting of one foreman, one welder, one truck driver, and four laborers, is $15/hr.

"The average total hourly cost to the company is therefore $65/hr. while the line is down for repairs.

"It may be argued that the maintenance crew expenses only should be chargeable to the repair job as their wages go on in any case. In the first place, a repair job almost always means large overtime payments which are equal to or greater than regular hourly pay, and in the second place, there is generally useful work at which the maintenance crew may be employed. Nowadays few companies carry repair crews for emergency work only."

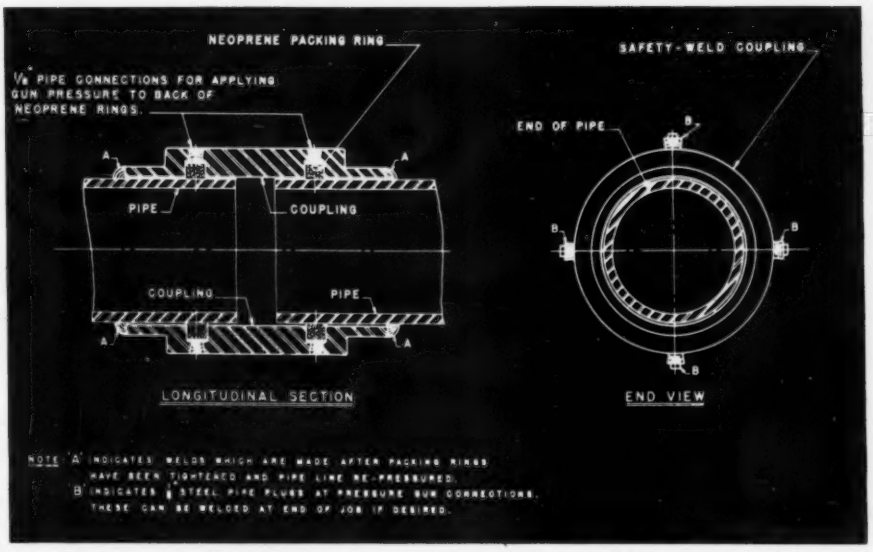


Fig. 1—Diagrammatic sketch illustrating working principle of the safety-weld coupling

TABLE 1—Annual Costs—100 Miles of 8-inch Crude Oil Pipe Line with and Without Safety-weld Couplings

	Without	With
Labor and expenses replacing 3 sections per year (20 hrs./section @ $15/hr.)	$900	$900
Lost revenue, 3 sections per year (16 hrs./section @ $50/hr.)	2400	....
Lost revenue, 3 sections per year (12 hrs./section @ $50/hr.)	....	1800
Six 8-in. Safety-weld couplings @ $50 each	....	300
Totals	$3300	$3000
Total annual savings using Safety-weld couplings	....	$300

Table 1 indicates the annual savings in the case cited will be $300, as worked out by Mr. Smith. He emphasized that these figures are not averages for 100 miles of 8-inch pipe. "They represent the savings only for the specific conditions described. Operators knowing their own conditions can readily determine if the savings would be greater or less on their own line," he stated.

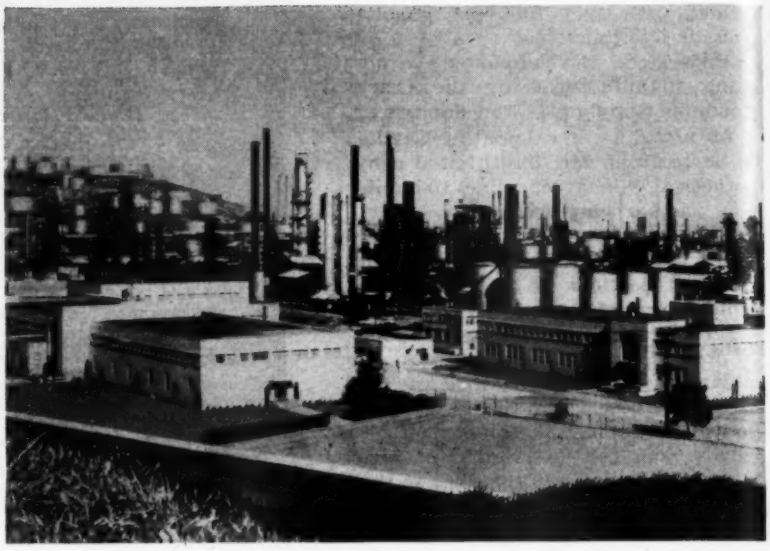
"We claim an average saving of four hours per section in shut-down time in the particular case cited. On some jobs, the coupling would save no time at all, on others it would save 12 hours, and on some jobs, 24 hours or more.

Fig. 4—Later—after line is in service and surrounding area is safe—coupling is arc-welded into permanent position

Fig. 5—Completed joint; the clamping bolts were removed after the first stringer bead had been applied

THIS MONTH'S COVER

Modern Research Uses Wide Variety Of Test Equipment



This month's cover shows the newly expanded laboratories of the California Research Corp. on the land adjacent to the Richmond refinery of Standard Oil Co. of California, parent company to the research organization

THE great diversity of equipment required in a modern petroleum refinery's research laboratory was demonstrated vividly when California Research Corp., a subsidiary of Standard Oil Co. of California, opened its newly expanded research laboratories recently at the Richmond refinery.

Apparatus being employed in studies at California Research include:

1. A flotation test cell—for testing the effect of petroleum-based foaming and wetting agents on the separation of finely divided, valuable minerals from their ores.

2. A conventional domestic washing machine and a "Launder-O-Meter"—for testing the effects of petroleum-derived detergents and synthetic cleansing materials on textiles and the like.

3. An injection molding machine —for evaluating petroleum-derived chemical components of the many new plastics and synthetic paints.

4. Automatic weathering machines —for testing paint surfaces.

5. Bench-scale and pilot-plant-scale processing units—for improving techniques used in the manufacture of products of the Oronite Chemical Co, a California Standard subsidiary, such as phthalic anhydride and alkanes.

6. The "Seasick Wheel"—a rotating device made to duplicate a ship's rolling motion, and employed to determine the effects of tanker shipments on liquid petroleum products.

7. A heavy compression testing press—for testing asphalt paving blocks, plywood glues, and other products made from petroleum.

8. Many other more conventional pieces of test equipment such as electron microscopes, X-ray diffraction apparatus, grating spectrograph, mass spectrometer, and infra-red spectrograph.

The Richmond Laboratories are located in three separate areas adjacent to California Standard's Richmond refinery. Overall, they include a total of 34 buildings with 175,000 sq. ft. of floor space (an average of 250 sq. ft. per employe).

Major parts in the $2,000,000 expansion program were the construction of a large, two-story process laboratory, and a north wing extension to the main administration and research laboratory buildings. Program also included remodeling of certain buildings, removal of several temporary structures, and the enlargement of employe parking facilities.

Activities by California Research Corp. fall into three general classifications: research, development, and technical service (for refining, production, marketing, and the customer). Achievements by the company include commercial-scale manufacturing processes for making phthalic anhydride and alkanes, mentioned briefly above, special-duty lubricants for marine use, a method for making toluene for TNT from petroleum, and the California Polymerization Process for converting otherwise unsuitable olefins to motor fuels.

Individual Laboratories

The new Process Laboratory building, of reinforced concrete construction with two floors and a basement, incorporates in its layout the general design of individual laboratories patterned after those in the main building. Like other major buildings on the property, it is built on piles, because the land was originally part of the bay, and the water table is only three feet below the surface of the ground.

It is completely air-conditioned and equipped with the latest safety devices. All electrical circuits of each laboratory room can be disconnected by a master switch located near the door. Provisions are made for a fire alarm system. This system, as well as the emergency lights are normally operated by alternating current; however, in case of power failure, there is automatic transfer to a battery-operated DC circuit.

A feature of the rear section of the building is in the functional walls. They are made of transite (a concrete asbestos mixture) to permit drilling holes for the introduction of process piping from an equipment platform located on either side of the building. The framework is of structural steel; the roof is metal decking.

Space-Saving Methods

A new method of mechanized storage utilized in the barrel storage area at the rear is said to have reduced the space required by one-third. Barrels are stored five-high by means of pallets and a mechanical lift truck on a concrete space, 125 by 220 ft.

In addition to the work handled at Richmond, California Research Corp. carries out patent and licensing work for Standard Oil Co. of California and its subsidiaries and affiliates. Home office is in San Francisco; other laboratories are situated at El Segundo and La Habra. Total personnel is about 850, of which approximately 675 are employed at the Richmond location.

Activities Began in 1919

California Standard's first activities in the field of research and development were inaugurated in 1919 with the organization of a relatively small group of workers at the Richmond refinery as a division of the manufacturing department. This was later made a separate department of the company, and together with the patent department was incorporated as a subsidiary in 1914.

The Effects of Acid and Alkaline Wastes And General Methods for their Disposal

By W. B. HART
In Charge of Waste Disposal for Atlantic Refining Co.

Acids and alkalies are used extensively in the petroleum processing industry as catalysts and treating agents. In some cases they must be disposed of after use, usually because their concentration becomes too low and recovery is uneconomical. They can't, however, be dumped indiscriminately into the nearest river or lake without creating a serious pollution problem. Their proper disposal, therefore, is a matter of concern to all refiners, large and small.

In this article, the author discusses acid and alkaline wastes, their effects on surface waters (primarily on pH), and methods of handling them. Two general disposal procedures are covered—controlled disposal, in which the waste material is discharged only in such quantities as can be diluted to a safe level by the available receiving water, and neutralization, in which the deleterious effects of the waste are neutralized prior to disposal.

ACID and alkaline wastes have occurred as a result of industrial activity since the earliest years of manufacturing. The quantity of waste produced in those early days usually was small and had little effect, because establishments were scattered and dilution was ample.

As industry developed, industrial wastes increased in both quantity and complexity. Acid and alkaline wastes also increased in quantity. In fact, the consumption of sulfuric acid and caustic soda became barometers of prosperity. Acid and alkaline wastes also became more complex as a result of more complex manufacturing processes. Today we encounter wastes which range from what might be regarded as simple solutions of acid or alkali in water, to such mixtures as wastes from the acid treatment of clays, the waste caustics from petroleum refining, and the acid and alkaline wastes of the pulp, paper and paper board industries.

Effects of Acid, Alkaline Wastes

The effects of acid and alkaline wastes on surface waters vary with the complexity of the waste. The effects may be those of simple acidity or alkalinity, or there may be associated effects, such as high dissolved solids, turbidity, oxygen consumption, or compounds causing tastes and odors. These associated effects are for present purposes unrelated, and they will not be considered here. In this article attention will be directed only to the acidity or alkalinity of wastes, and the manner in which these conditions affect pH. The types of wastes for which treatments will be discussed and described are those which simply are acid or alkaline, and not complicated significantly by other polluting components.

The logical approach to a problem in waste treatment and disposal is one in which the attack is made on the adverse effects of the waste. To use this approach it is necessary to know what is affected, and how it is affected. Acid or alkaline wastes affect first the surface waters into which such untreated wastes are discharged, and in excessive amounts they affect all the uses of these waters, and all the aquatic life they contain or which is dependent upon them.

No surface waters are pure. The solvent action of water is too great to permit this, and consequently surface waters contain dissolved mineral matter ranging from concentrations as low as 10 or 15 ppm. to 500 ppm. or more. Highly alkaline waters of some lakes and streams of the west and southwest and the desert countries contain dissolved mineral matter in concentrations of the order of 30,000 to 40,000 ppm. These waters will not be considered here, however, for they are of little consequence in the general waste disposal problem. Only the usual quality of surface waters will be given attention.

Principal Components

The principal mineral components of these surface waters are bicarbonates of calcium and magnesium, and the dissolved gas, carbon dioxide. These three components exist in a sort of equilibrium. The carbon dioxide exists partly as free dissolved carbon dioxide (CO_2), and partly as carbonic acid (H_2CO_3). The surface waters themselves, therefore, possess acidity and alkalinity which is measurable by the usual methyl orange titration. The intensity of acidity or alkalinity demonstrates itself in terms of pH, which is a measure of hydrogen ion concentration in the case of acidity, and hydroxyl ion concentration in the case of alkalinity.

Carbon Dioxide Affects pH

The pH of a water will change without change of calcium or magnesium content if the carbon dioxide is increased or decreased. This will bring about an increase or decrease of carbonic acid, and cause increase in hydrogen ion concentration or hydroxyl ion concentration. Consequently, there will be a lowering or raising of the pH value on the pH index scale. In nature, however, there is constantly an effort on the part of gases to reach, in concentration, an equilibrium with the concentration of the gas in the atmosphere above the water. By this action excessive concentrations of carbon dioxide are prevented by the gas passing off to the air. Some carbon dioxide also may bring about solution of calcium carbonate as calcium bicarbonate. Thus, there results a rather constant pH in the surface waters, which under natural conditions is little disturbed. One of the first effects of either acid or alkaline waste is to disturb this balance.

When an untreated acid waste is discharged into a body of surface water the first action is upon the bicarbonates in the water. The metal-

lic ion, i.e., the calcium or magnesium, is taken out the condition of balancing between carbonate and bicarbonate (which is a part of the buffer action of the water) and is fixed as a salt. This is exemplified by the equation:

$$Ca(HCO_3)_2 + H_2SO_4 \rightarrow$$

$$CaSO_4 + 2H_2O + 2CO_2$$

From this equation it can be seen that the calcium becomes fixed as calcium sulfate, and considerable carbon dioxide is formed. But this carbon dioxide will not react with the calcium sulfate for the sulfate is stable. The carbon dioxide can only react with any calcium carbonate which may be present (e.g., in bottom sludge), or escape to the air.

pH Is Depressed

As more and more calcium bicarbonate is destroyed by the continuous discharge of the acid waste with equivalent generation of carbon dioxide, the pH is depressed. This drop in pH is slow at first, due to the buffer action mentioned above. But when all the calcium bicarbonate has been destroyed, the drop in pH is rapid. Also, when all the bicarbonate has been destroyed, one of the most important characteristics of the surface waters will have been destroyed. Finally, below pH 4.0 to 4.5, mineral acidity is present.

As the pH of the waters receiving the acid waste is depressed, the usefulness of these waters also is lowered. That corrosion will present a problem in using the water of a stream contaminated with acid should be obvious, whether the use be either commercial or navigational. Further, such water will require treatment before it can be used industrially or as raw water for domestic supply. All treatment procedures which would correct the acid conditions are costly, and the acid discharge from a single establishment may affect many other establishments on the same stream or lake.

Acidity Affects Organisms

Acidity seriously affects the life in surface waters. This affect may take any one of three general forms. It may so affect the waters that all living forms, with very few exceptions, will be destroyed. The effect may be one which will drive away all the less resistant forms leaving only a few unimportant ones.[1, 2] Or it may be that the environmental changes are only slight, yet sufficient to cause many organisms to seek more satisfactory surroundings, thereby upsetting the ecological balance of the water to a degree which will interfere with some of its uses.

Alkaline wastes act upon surface waters in a manner similar to acid wastes, but in the opposite direction with respect to the pH index scale. Both carbonates and hydroxides act first to destroy the bicarbonates present converting them to normal carbonates, and the insoluble forms are precipitated (e.g. $CaCO_3$). Finally, all bicarbonates are converted to the normal carbonate form. Up to this point (the pH of which is of the order of 8.3 to about 11.0, depending upon the particular natural water), the change in pH is relatively slow. Beyond this point the pH increases rapidly, because all buffer effect has been overcome. Real causticity develops in this range, and serious effects follow.

Although the corrosive effects of waters contaminated with high alkalinity are not as great as in the case of high acidity, the increase in dissolved solids presents a problem in their use. Also, the effects of high alkalinity on aquatic life are almost as serious as, and in some instances are quite similar to, the effects of high acidity.[3]

Unusual Forms

Attention also should be directed briefly to certain unusual forms of contamination such as high concentrations of carbon dioxide, solutions of hydrofluoric acid, the sulfonic, naphthenic, and other organic acids, which are really toxic in their effects. Of these, only carbon dioxide and hydrofluoric acid will be considered at this time.

Space permits only the briefest discussion here of the effects of acid or alkaline wastes. For more detailed information the reader is referred to reference cited at the end of the article.[4-8]

To prevent the adverse conditions in surface waters which will be brought about by the discharge of untreated acid or alkaline wastes various treatments have been devised.

Basic Treatment Methods

Two fundamental procedures have been used for the treatment of acid or alkaline wastes which affect pH: controlled disposal and neutralization. As to which of these procedures is employed depends largely on the nature of the waste, particularly its quantity, in relation to the available receiving water (i.e., water into which the waste is to be discharged). Other factors are the manner in which it is discharged, with respect to continuous or batch discharge, and the associated potential pollutants, which are not a part of this article but do play a part in making a decision as to disposal procedure.

Controlled disposal is applicable when only a relatively small amount of waste is to be discharged, even though the acidity or alkalinity may be quite pronounced. The procedure also is usable when there is even a rather large amount of waste provided the acidity or alkalinity is not too high. Controlled disposal is particularly useful when the acid or alkaline waste has as associated potential polluting characteristics high dissolved solids, turbidity, or suspended matter.

Combination Is Effective

When controlled disposal cannot be used successfully, neutralization must be used either alone or in combination with controlled disposal. There are numerous ideas as to the simplicity which attaches to the neutralization of an acid or alkaline waste. Actually there are a number of "little things" which can mean a successful and satisfactory treatment process, or an unsatisfactory one.

For example, it often is considered necessary to use a high calcium limestone for neutralization because it is the general idea that lime should be used for neutralizing, and calcium oxide (CaO) is lime. There are conditions which require high calcium lime, or limestone, but there are many other instances when it does more harm than good. This can be the case when sulfuric acid is to be neutralized, for a hard calcium sulfate scale often forms which plugs lines, and perhaps the entire equipment. The use of a magnesium limestone will prevent much of this difficulty, and pound for pound will neutralize more acid. And magnesium sulfate is very much more soluble than calcium sulfate, as a result of which there is less sludge. This solubility ratio is greater than 100 to 1 of the pure salts.

Limestone Used Frequently

It is true that the rate of reaction between magnesium limestone and sulfuric acid is slower than that between high calcium limestone and sulfuric acid. Even though this reaction rate is slower, magnesium or dolomitic limestone can be made competitive with high calcium limestone by increase in temperature or by aeration. Limestone is used frequently to neutralize acidity. This application of limestone often is found where there is acid waste of low concentration but relatively high volume to be treated. Sometimes the process is effective, but as often as not, because the neutralizing bed is constructed and filled improperly, the results are disappointing. The usual manner of neutralizing bed construction is illustrated in Fig. 1. In actual practice, a bed constructed as in Fig. 1-b reduced the sulfuric and sulfurous acidity from 5000 ppm. to only 3000 ppm. The cause of the low efficiency of neutralization nearly always is the film of calcium sulfate which forms on the stone and prevents intimate

contact. This layer sometimes is coated in turn with a layer of biological growth. When this occurs, little or no neutralization takes place.

It would be a grave error of omission if there were not included here a warning against mixing an alkaline or an acid waste with another of opposite character, which may be produced on the same plant, without first carefully investigating the result of the procedure in the laboratory. This sort of waste treatment has been resorted to without preliminary study in plant practice under pressure for pollution abatement from State agencies, or with the idea that it will be inexpensive. But often the result presents a problem in waste treatment which is much more difficult to solve than the problem of either waste separately, and more costly than the combined costs of the two separate treatments.

To be effective, any neutralizing agent used for treating acid or alkaline wastes must be in a form which will permit intimate mixing and contact with the waste, or must be applied in a manner which will bring such mixing and contact about. In the sections which follow, controlled disposal and neutralization processes will be discussed in some detail.

Preliminary Considerations

Before consideration is given any sort of treatment for acid or alkaline wastes, there should be a clear understanding of the degree of treatment required by such a waste. This information can be had only from a careful study of each individual treatment problem. The data necessary are:

From the waste:

1) The continuity of discharge, i.e., whether intermittent or constant.
2) If constant, the uniformity of rate and the maximum and minimum rate.
3) The presence or absence of potential pollutants other than acidity or alkalinity, to a degree which will place the problem in an entirely different class.
4) The acidity or alkalinity of the waste, the uniformity of this characteristic, and the maximum and minimum of the range.

From the surface water which is to receive the treated waste:

1) The uniformity of rate of flow past the point of discharge. This means near to the discharge, and applies especially when the discharge is in an indentation in the bank of a stream, or when the receiving water is a lake. If a lake, the currents should be studied carefully.
2) The minimum rate of flow past the point of discharge.

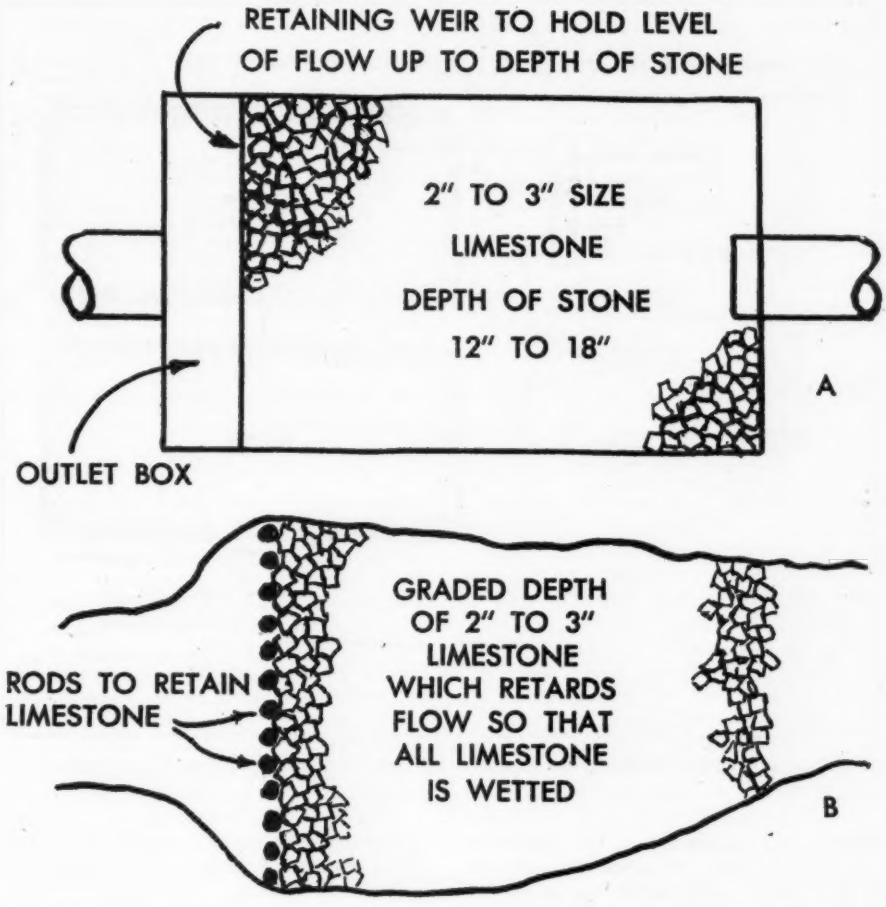


Fig. 1—At (A) is shown the usual limestone neutralizing bed construction; at (B) is a bed used in actual practice which provided very low efficiency

3) The pH of the water, and the maximum and minimum of any range of variation.
4) The total dissolved solids of the receiving water, and the maximum of the range of variation.

The degree of treatment will depend upon the data which result from the survey. The purpose of the degree of treatment should be that in the receiving waters:

1) The pH should not be depressed below 6.0 to 6.5, or raised higher than 8.0 to 8.4.
2) When the pH of the receiving waters constantly is either lower or higher than these limits, this natural pH should not be exceeded, in either direction, in significant degree.
3) The dissolved solids in the receiving water should not be increased to exceed 500 ppm. unless solids naturally are in solution in excess of this value. This excessive but natural concentration should not be increased appreciably.
4) If aquatic life in the receiving waters is an item of very special importance, alkaline waters should not be made even slightly acid (i.e., changed from above to below pH 7.0) or vice versa.

Treatment by Controlled Disposal

Controlled disposal means disposal of an untreated waste in a manner, or at a rate, which will not affect the receiving waters, or the life forms in and about the waters, so as to interfere with any of the uses of these waters. The procedure depends upon two factors for its success. First, there must be ample receiving water to provide sufficient dilution, and a continuous current to carry away the waste. Second, the receiving water must be of the desired pH or well buffered, or of such a nature that it will permit, as a result of its uses, a change from mild alkalinity to mild acidity, or vice versa. Controlled disposal is not generally applicable, but can be used in a great many places where the waste volume is not too great nor its pollution potential too high.

One of the essential features for the controlled disposal process may be storage capacity. A waste may be produced intermittently at a rate which would not permit disposal in

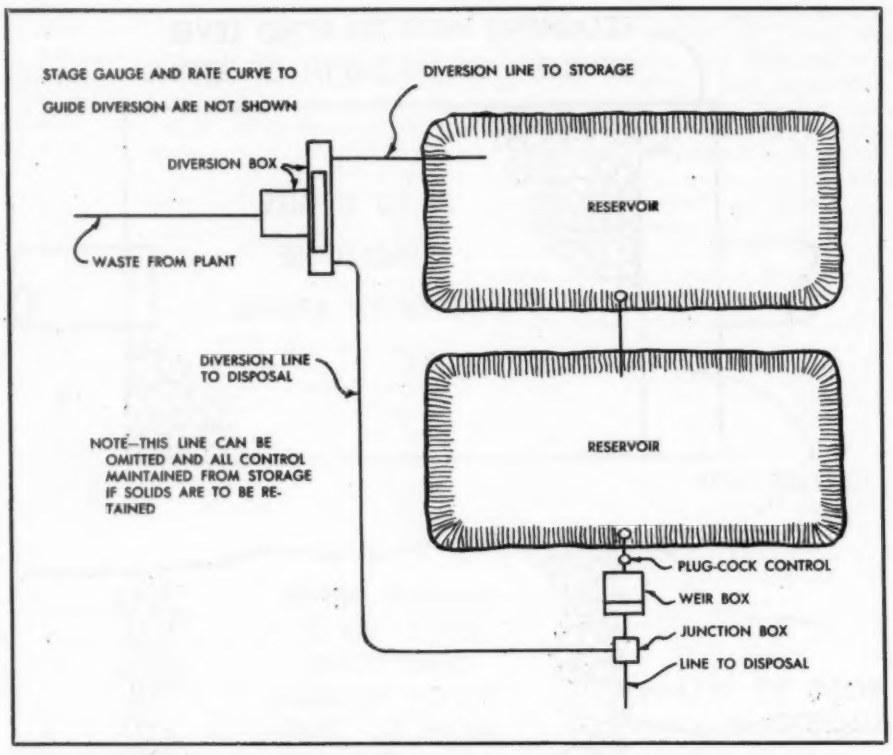

STAGE GAUGE AND RATE CURVE TO GUIDE DIVERSION ARE NOT SHOWN
DIVERSION LINE TO STORAGE
DIVERSION BOX
WASTE FROM PLANT
RESERVOIR
DIVERSION LINE TO DISPOSAL
NOTE—THIS LINE CAN BE OMITTED AND ALL CONTROL MAINTAINED FROM STORAGE IF SOLIDS ARE TO BE RETAINED
RESERVOIR
PLUG-COCK CONTROL
WEIR BOX
JUNCTION BOX
LINE TO DISPOSAL

Fig. 2—Diagram of diversion and storage for "controlled disposal" procedure

untreated condition. If the waste is stored, however, it often is possible to discharge constantly at a lower rate, and one which will not damage the receiving waters. Further, it may be possible to discharge a continuously occurring waste into a stream which is at a certain stage, or rate of flow, but this will not be possible if the stream flow rate falls off. Some of the waste then must be stored. This introduces another essential.

This second essential is a device for controlling the rate of discharge. It may be necessary also that the device include a means for diverting some or all of the current production of waste to storage. This will be determined by a third necessary bit of equipment, i.e., a stage gage. From the reading of the stage gage, as applied to a flow rating table, the available stream flow quantity, or current in a lake can be established. Then the amount of waste that it will be possible to discharge directly can be calculated or determined from a chart or curve. The interrelationship of these various devices is shown in Fig. 2.

It is useless to attempt any description of storage facilities, for they will have to conform to the requirements of the plant they are to serve, and to the topography of the area available. They may be composed of tanks or of excavated reservoirs. There is one important detail—the reservoir facilities should not leak. Seepage from impoundment basins frequently has led to costly suits. The importance of this detail cannot be over emphasized.

The reservoir facilities are equipped with a device by which their content can be discharged to the receiving waters at times of high flow, for it is desirable to retain as little waste as possible, thus having the facilities available in full capacity when needed.

Much could be written about devices for diverting the current waste flow to storage, as indicated to be necessary by the flow rate of the receiving waters. However, the ingenuity of the plant personnel usually can be relied upon to meet the requirements of design. A "Diversion Box", for want of a better term, should readily direct all the waste to the receiving waters, or to the reservoir as necessary, and should be so designed that 5% subdivision of the flow is possible with a reasonable degree of accuracy.

When storage capacity is used simply for retaining an intermittent flow to permit discharge at a practically constant rate, it is rather simple to calculate and install orifices for rate control. There will be some difference in rate as a result of variation of the head on the orifice, but this can be minimized by giving the storage as great an area as possible so that the depth of the waste in the storage will be low, and the rate of change of the depth will be minimized.

For flow of waste from storage to the receiving waters, when the latter are high and the waste in storage can be reduced, a V-notch weir for measurement, and a valve or plug-cock for control, has given good service. A table can be prepared showing the head on the weir converted to rate of flow, so that operators will know just what to do.

Finally, a convenient form of over-

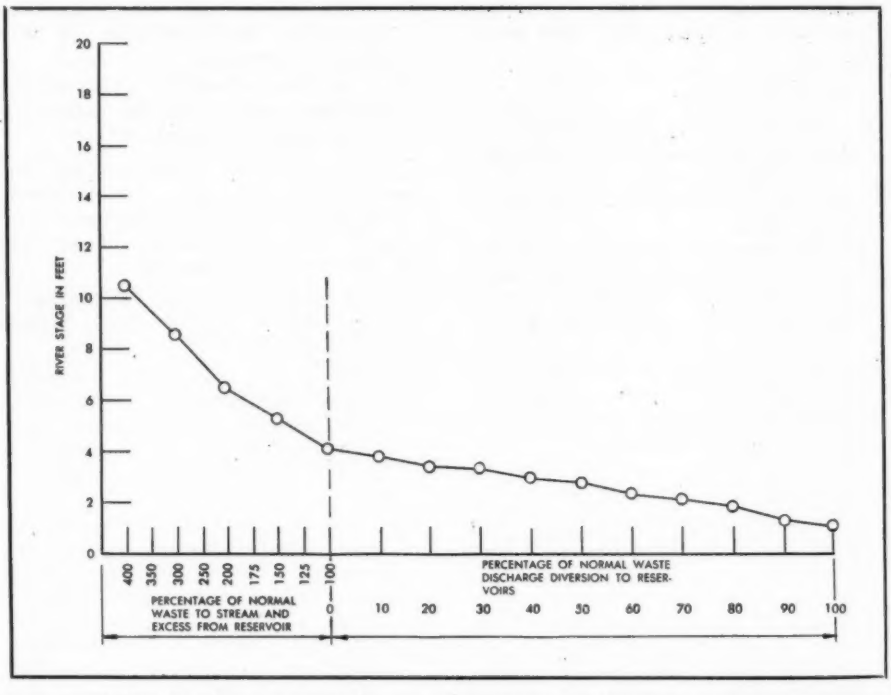


Fig. 3—Typical discharge control curve; based upon the waste rate in relation to the stream. This relation must be established for each problem to meet the individual requirements

all control curve is shown in Fig. 3 It presents one idea of how an overall control can be maintained. The curve shown represents actual practice. It was calculated on the total dissolved solids content of a waste having the following characteristics:

Total Dissolved Solids.....	30,000 ppm.
Free Sulfuric Acid	15,000 ppm.
pH	0.5

The curve is based upon discharge into a stream in which the total dissolved solids average 30 ppm. The final mixture in the stream showed total solids never in excess of 450 ppm. and a pH consistently just under 6.8. The normal pH of the stream was of the order of 6.8.

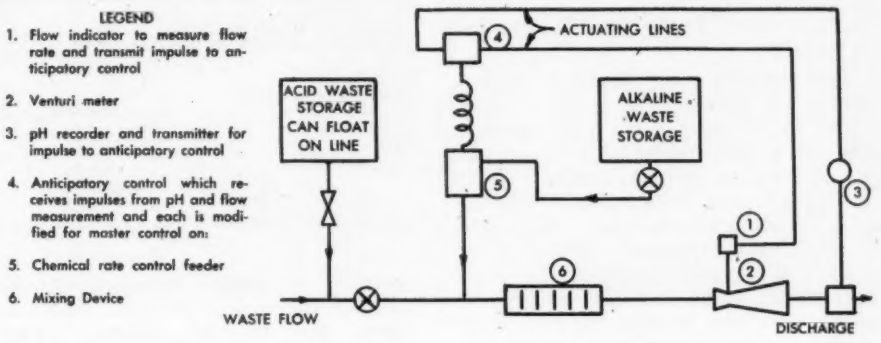

LEGEND
1. Flow indicator to measure flow rate and transmit impulse to anticipatory control
2. Venturi meter
3. pH recorder and transmitter for impulse to anticipatory control
4. Anticipatory control which receives impulses from pH and flow measurement and each is modified for master control on:
5. Chemical rate control feeder
6. Mixing Device
ACTUATING LINES
ACID WASTE STORAGE CAN FLOAT ON LINE
ALKALINE WASTE STORAGE
WASTE FLOW
DISCHARGE

Fig. 4—Arrangement of equipment for well-controlled neutralization of one waste with another of opposite reaction

Treatment by Neutralization

By Mixture with other Wastes of Opposite pH: Wherever an industrial establishment has wastes which can be mixed to bring about neutralization, without associated undesirable reactions, that establishment is fortunate indeed. Considerable money and general effort will be saved, even though one of the wastes must be brought in from a neighboring process. But the neutralization will not be satisfactory if carried out in a haphazard fashion. The process must be controlled carefully.

First, from laboratory investigation there must be assurance that the neutralization will result when the available wastes are mixed, and that no undesirable reactions or conditions will follow. Second, there must be assurance that the composition of the wastes will remain reasonably constant so the desirable conditions will be maintained. The actual processing is rather simple, and to save space is shown in flow-sheet form with explanatory notes in Fig. 4. The final pH of the discharge can be set at any level which investigation of the receiving waters has shown will not be harmful.

Equipment Rather Simple

When laboratory study shows that this procedure is possible the equipment necessary is rather simple. Storage should be provided for each of the wastes. Lines from each set of storage tanks lead to a baffle type mixing box which discharges to the sewer. A pH recorder should be placed on the discharge line and in more elaborate installation the pH meter can be made to actuate flow control and other necessary features. The actual details of such a neutralizing plant must be based, of course, on the conditions and requirements of the industrial establishment.

By Limestone Beds: Although this process of neutralization is not recommended generally because of its low efficiency, there may be instances where it will be useful to correct very low acidities in small volumes of waste.

In designing a limestone bed for neutralization, too often little attention is given the size of the stone and the rate at which the waste is applied. Because of the need for high surface ratios to permit good contact with the waste, only crushed stone should be used. Sizes between ¼ and ½ in. will support themselves and also allow good flow-through. Smaller sizes, because of foreign matter released when the stone dissolves, and also because of suspended matter which may be present in the waste, may result in very low filter rates.

Ample area should be provided for waste application, which should not exceed about 20 gals, per sq. ft. per min., for the reaction is relatively slow. Acidity of the waste applied should not exceed about 4000 ppm., resorting to dilution if necessary, to avoid precipitation of calcium sulfate.

The neutralizing bed can be constructed on a ditch or sewer system. The principal items of design are good distribution over the bed surface. The bed thickness need not exceed 12 to 15 in.

By Use of Limestone in Up-Flow Filters: Little need be said here about this procedure which, if not the best, at least is one of the best methods for neutralizing mineral acidity. The idea of up-flow filters was developed by Gehm, and its fundamentals so completely reported by him[9] that nothing further is needed except actual design. This, of course, will depend upon local conditions.

Only one exception need be noted in connection with the report, concerning the use of dolomitic limestone. Stone of this type can be used if proper allowance is made for the slower reaction, or if the waste can be heated.[10] The higher capacity of dolomitic limestone for neutralization, and the greater solubility of magnesium sulfate, which results in less sludge, make the use of this type of limestone desirable wherever it is possible.

Limestone beds do not often provide complete neutralization. Consequently, the effluent must be checked frequently to assure that mineral acidity has been reduced to a point which will not harm the receiving waters.

By Use of Lime and Chemical Feeders: Here again there is little need for detail. There are numerous vendors of chemical feeders, and the practice is an old one. It has been developed largely for water purification, however, and the problem in waste treatment is somewhat different, for the concentration of acid in waste usually is much higher.

For the process to be satisfactory, the waste acidity again should be kept below 5000 ppm. The use of dolomitic lime has even greater opportunity in this process for the rate of reaction can be increased by agitation with air. Actual treatment plant construction is not too difficult and much information can be had from vendors of both lime and equipment.

Neutralization of Alkalinity

By Acid: The neutralization of alkaline waste by use of an acid waste has been discussed and proper caution advised. However, reasonably pure acids are used for neutralization of alkaline wastes under properly controlled conditions. Usually this process is carried out using chemical feeders designed for introducing liquids with rate controls. Information on this procedure is available from vendors. The acid can be fed right into the waste stream provided there is ample turbulence to assure good mixing, or an orifice or baffle type mixer can be inserted in the flow beyond the acid addition.

When available, or when necessary for the purpose, hydrochloric acid should be used, for the chloride ion is considerably less damaging to aquatic life than the sulfate ion. Also, its neutralizing capacity is greater.

By Carbon Dioxide: There are occasions when carbon dioxide can be used to advantage for the neutralization of alkaline wastes. The carbon

dioxide can be made available from furnace stack gases or from undersurface gas burners.

When using stack gases it is necessary to make a connection to a stack breeching or flue and carry a line of proper capacity through an indirect cooler to an exhauster. The exhauster then discharges into a long distribution pipe laid lengthwise in the waste stream. The pipe is drilled with outlet holes at short intervals, the holes directed at an acute angle with the bottom of the ditch or flume down which the waste flows. There should be excess capacity for gas discharge to allow for variation in carbon dioxide content in the flue gases, and there should be careful calculation of the carbon dioxide necessary to assure ample equipment size. The alkalinity of the waste, for satisfactory operation, should not exceed 10,000 ppm., resorting to dilution if necessary. Laboratory investigation should be conducted to establish best design and practice for each individual plant.

Burn Gas for Carbon Dioxide

When ample natural or other combustible gas is available, the undersurface burner can be used to introduce carbon dioxide for neutralizing alkalinity. This burner extends down into the waste flow as a cone with the base open. The burner is located inside the cone and is fed by a line from the cone apex. The fuel, a mixture of air and gas, is introduced at a pressure greater than the hydrostatic head at the cone base. The entire burner is enclosed in a tank through which the waste flows.

As the waste flows through the tank, the products of combustion from the burner escape from under the rim of the cone, and bubble up through the liquid, affording a very efficient mixing and neutralization. A very satisfactory continuous waste treatment can be arranged using several of these burners either in series, when the alkalinity in the waste is pronounced, or in parallel, when a large quantity of weakly alkaline waste must be treated. The equipment can be purchased in units.

Procedures Should Be Studied

Some neutralization procedures may rather readily be carried through to completion. Others may not be so complete in effectiveness but will produce an effluent which will be satisfactory for the surface water involved. That such an effluent will be produced should be assured by investigation before any process which will bring about anything less than complete neutrality is selected.

It also should be understood that there are wastes which are so great in quantity, or so strong, that neutralization is not practicable because of the cost of neutralizing agent, the quantity of sludge which would result, or the lack of dilution water to carry the treated effluent away. Such wastes are pickling liquors, acid mine waters, and some others. These problems remain to be solved.

TABLE 1—Effect of Excess Lime in the Treatment of Wastes Containing Fluoride Ions

mg. Lime per mg. F- Removed	Res. Hardness, ppm.	Res. F-, ppm.	pH
1.49	0.0	660	11.58
2.03	89.0	38.2	11.60
4.03	410.0	16.5	11.64
8.05	395.0	8.2	11.70

Treatment of Excessive Co_2

Some wastes have as a principal characteristic excessive quantities of carbon dioxide. This also may be true when complete neutralization is attained using limestone in up-flow beds for neutralizing acid wastes. The pH of such an effluent will be of the order of 4.2 to 4.6.

Carbon dioxide is highly toxic to aquatic life, and also contributes to corrosion, and in many instances it will be necessary to remove it. Because of its relatively low solubility this can be done rather simply. A waste of this character, or an effluent from acid neutralization with limestone, contains a reserve pH which can be attained by either agitation with air or by spraying the solution into the air. Even fall over a weir, or dam, will raise the pH by removal of the carbon dioxide. Agitation or spraying will quickly raise the pH from 4.2 to 6.0 or 7.0, at which level the waste usually is entirely satisfactory for discharge to the surface waters.

Treatment of HF Wastes

The recent war brought about a great demand for high octane aviation gasoline. As a result, the hydrofluoric acid alkylation process came into extensive use. This process produces wastes which contain the fluoride ion in somewhat extensive amounts.

Calcium fluoride is soluble to the extent of 16 ppm. at 18° C. so it would seem possible to eliminate the fluoride ion readily. But 16 ppm. in the waste effluent can be too high, because this ion presents a serious health problem in excess of about 1.0 ppm. in domestic water supplies.

Weston, working on the problem of a treatment for such a waste, found that an effluent containing only about 8 ppm. could be obtained by using an excess of lime.[11] This excess is indicated in Table 1.

The process permits treatment and disposal with the requirement of only half as much dilution.

The fundamental of the process is the precipitation of calcium fluoride in the presence of excess lime. Best results were obtained using a batch procedure in alternate tanks, permitting each charge to settle before discharging the supernatent. The residual sludge is transferred to a drainage pit to permit retained water to seep to a connection with the main discharge.

Disposal Equipment and Controls

Particular attention should be given the introduction of treated effluents to obtain rapid and complete admixture with the receiving surface waters. Methods have been described in previous articles by this author.[4]

The control of the quality of effluents from treatment of acid or alkaline wastes can be maintained by determination of pH. A recording device is desirable in order to maintain a continuous record when needed for authorities.

It is also important to keep record of dissolved solids so that these will not be excessive in the receiving waters and create undesirable osmotic conditions.

Treatment of fluoride wastes can be controlled by testing 25 ml. of the waste diluted to 100 ml. Add 5 ml. of alizarin indicator and titrate with dilute nitric acid to a pure yellow color. If the addition of thorium reagent then produces a pink or light pink color the charge is satisfactory for disposal. If the yellow color remains, further treatment is necessary.

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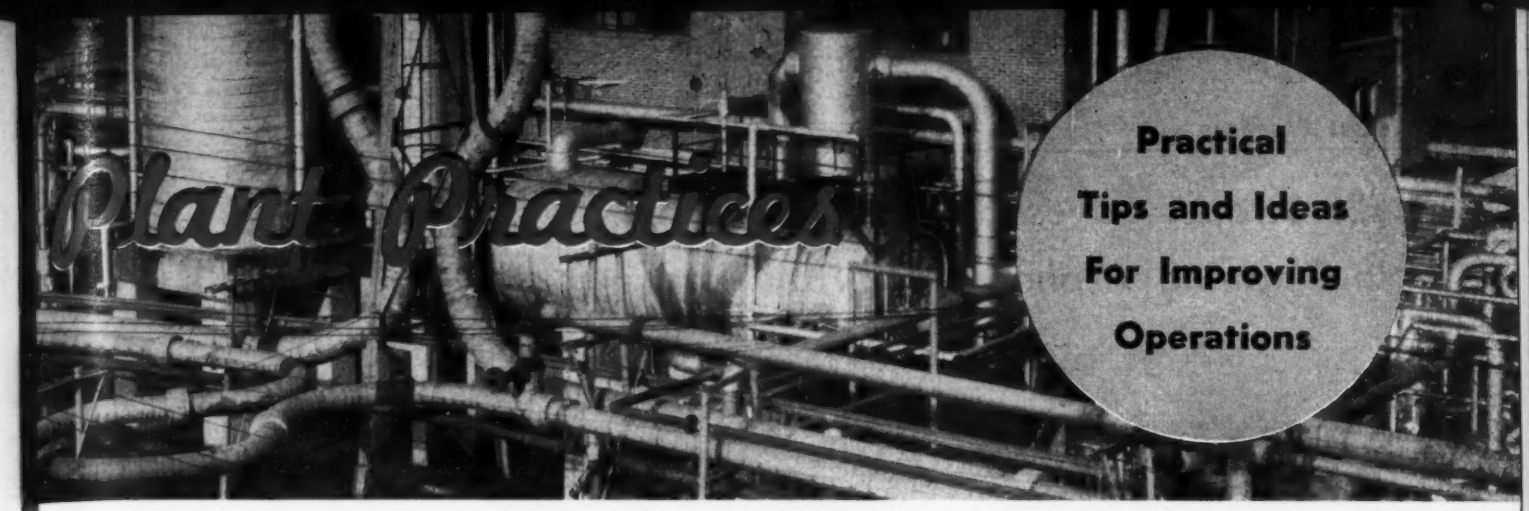


Obtain Long Life in Plunger Pump Packing By Using Force-feed Lubrication System

By JOHN C. ALBRIGHT

WASTE water pumps usually "take a beating" because of the characteristics and contamination of the fluid being handled, but with packing intelligently applied on chrome plated pistons in outside-packed plunger pumps, the Hancock Oil Co. has used the same set of packing for as long as 28 months without replacing any of the rings or segments.

Two large steam-driven duplex outside-packed plunger pumps, installed at the waste water disposal pits in the company's refinery at Signal Hill, Calif., pick up water drained from processes in the plant, and deliver it "as is" to the disposal system.

Due to contamination of the water by sediment, chemicals, and corrosive liquids, common steel plungers soon became scored regardless of the care taken. Packing the glands was sometimes required every few days, and sometimes daily. The operation involved removing the plungers from the cylinders, cleaning and coating them with chrome, and subsequently grinding and polishing them to as smooth a surface as practicable.

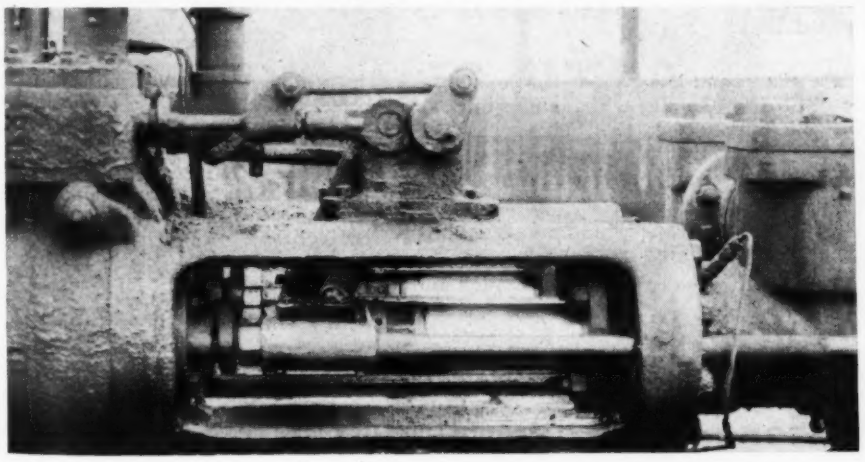
After reassembling the pumps, the master mechanic studied the packing problem carefully to find a method of packing and pump operation that would eliminate this too-frequent shutdown.

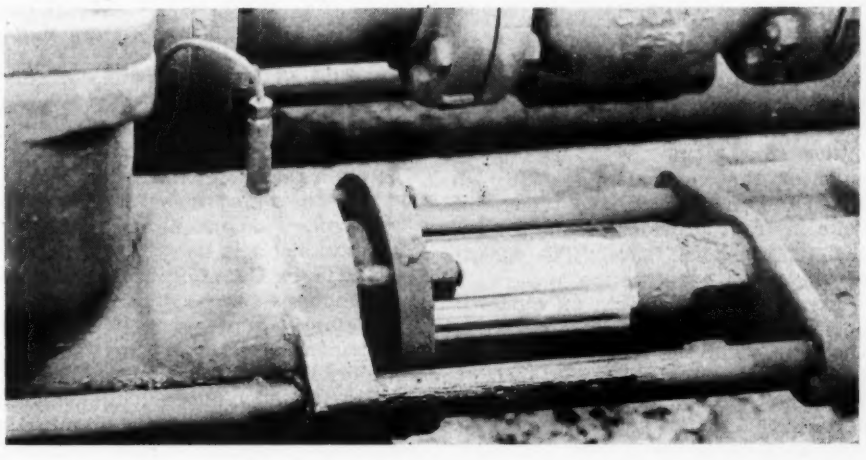
The plan ultimately adopted included reworking the stuffing box for using conventional packing and installing a method for supplying effective lubrication to the plungers. A ring was made in the refinery shops with a narrow margin of fit inside the stuffing box and adequate clearance when placed on the plunger.

This ring is one inch wide and is perforated around the entire circumference by drilling. To supply lubrication, a hole drilled in the case of the pump entered at a point coinciding with the inside edge of the ring after installation, as shown in the photographs.

Packing consisting of three rings of Garlock "550 Duck & Rubber" filled the stuffing box ahead of the special ring. Additional rings of the same material followed for compression by the packing gland.

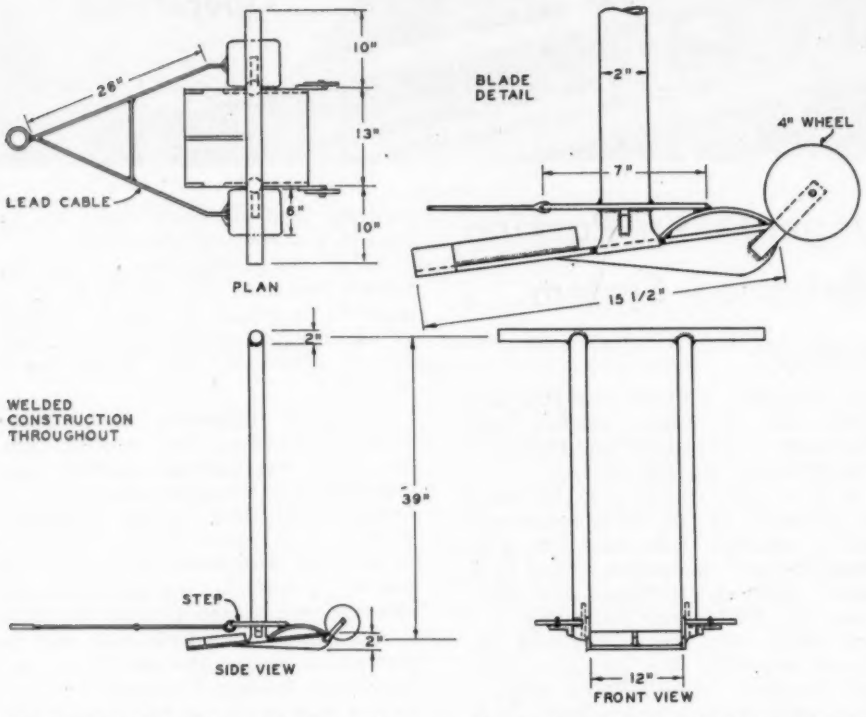
Conventional, force-feed lubricators installed on the pumps, with separate compartments, one for steam lubrication and the other for plunger lubrication, supplied oil to the required points on the pumps. After the pumps were revamped, many months passed without a leak except for the normal sweating common to most packing glands.





In photo above: force-feed lubrication system fitting has been installed at stuffing box just to the right of the packing gland. In photo at right: another fitting at the opposite end of the duplex pump has also been installed at the stuffing box, just to left of packing gland

$25 Scraper Saves Half of Labor Costs In Cleaning Asphalt from Tank Bottoms



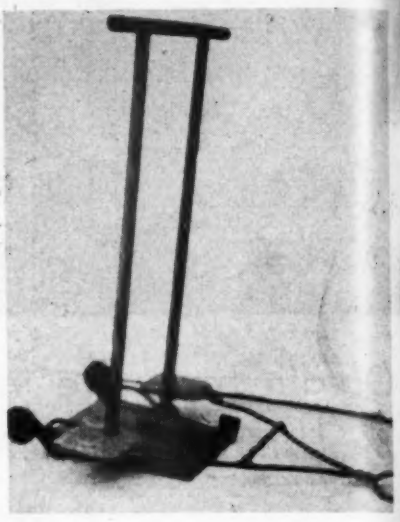


Fig. 1—Detail drawing of inexpensive scraper for removal of asphalt from storage tank bottoms, shown also in photos at right

COSTING about $25 to build from scrap parts, an improved type of tank bottom scraper, in use at Humble Pipe Line Co., League City, Texas, does away with a previous, slow, laborious method of removing asphalt from tank bottoms with hand tools. Up to half the labor cost required to do the job with sharpshooters and hand scrapers is saved by the use of the tool, company engineers state.

Developed by J. E. Fuller, of the company's engineering department, the device can be operated by two workmen using an air hoist for motive power. It consists of a framework made of 2-in. pipe, as shown in Fig. 1.

Mounted on this frame are two 4-in. discs serving as wheels and a flat-bladed scraper which cuts a 12-in. swath through the asphalt. Steps at either side, connected to the lower ends of the vertical pipes, furnish space for one operator to stand. A yoke in front provides means for attaching the hoist cable. The tool is of all-welded construction.

In use, the cable from an air hoist operated by one man is attached to the yoke, while the other man mounts the implement, placing his feet on the steps. The hoist pulls the scraper across the tank bottom, and the weight of the operator, plus the angle of the blade and the pull of the hoist, plows off the asphalt, which slides out between the operator's legs. The scraper is then pulled back across the tank, aimed, and the operation repeated.

The asphalt scraper has been redesigned several times in the course of its trial period. In its present form, it has been in satisfactory use for about four years.

Scrubber Device Cuts Cooler Surface 50% In Condensing Gas-plus-Gasoline Mixtures

By G. W. STEPHENSON, General Superintendent
Southwestern Oil Refining Co., Corpus Christi, Texas

APPROXIMATE savings of 50% in cooler surface can be realized in cooling hot gasoline contaminated with "uncondensable" gases through the use of a small exchanger and counter-current scrubbing of the remaining vapors against gasoline. The method is in use at Southwestern Oil Refining Co.'s Corpus Christi, Texas, refinery for condensing gasoline containing appreciable volumes of propane and lighter constituents of the crude distillation unit.

Fig. 2 shows how the exchanger and scrubber are connected into the system. Gasoline vapors exchange heat with incoming cold crude, being cooled to approximately 150°F., and the heavier constituents are condensed.

All of the C_3 and lighter, plus most of the light ends of the gasoline, remain in the vapor phase, however. These pass into the base of the scrubber, where any water present separates and is drawn off, while the vapors rise into the scrubber. The scrubber contains four or five bubble trays, over which condensed gasoline is pumped at a temperature of about 85° F., scrubbing the ascending vapors counter-currently. "Uncondensa-

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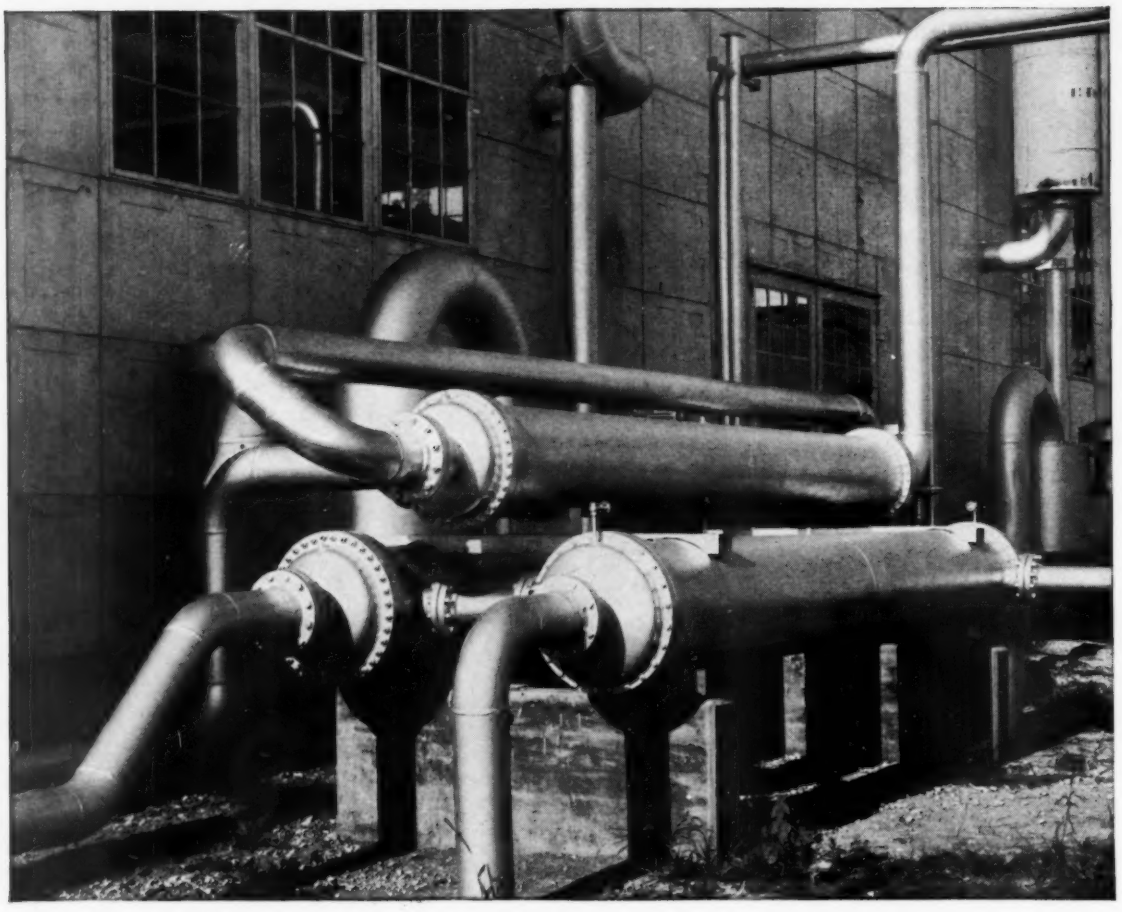

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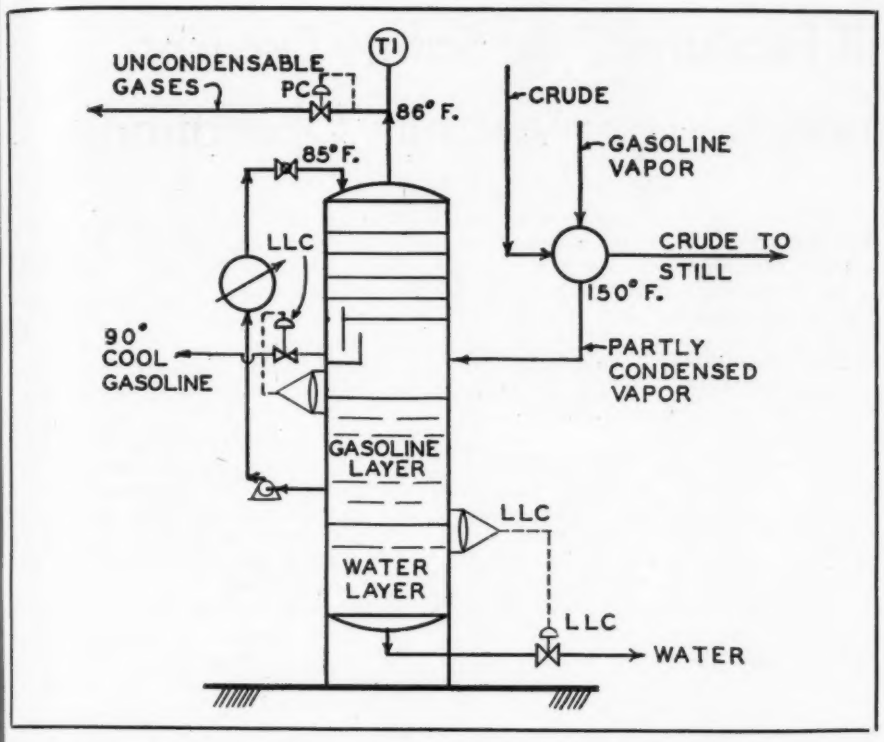

Fig. 2—Flow diagram of exchanger-scrubber arrangement to cool gasoline vapors containing uncondensable gases

ble" vapors are taken overhead through a back pressure regulator.

The system shown in Fig. 2, instrumented as indicated with two liquid level controllers, and a temperature indicator in the vapor exit line, requires minimum attention and is very useful also where reformer gasoline is being condensed. In such cases a considerable volume of hydrogen is present in addition to hydrocarbon vapors.

Dresser Sleeve Is Revamped and Adapted For Use in Steam Line Expansion Joint

By ROY W. MACHEN

IN A LONG run of exhaust steam line it is necessary to allow for line expansion. At one of the Texas Gulf Coast independent refineries, such expansion was provided by revamping a Dresser sleeve, as shown in Fig. 3.

The exhaust steam line was in itself an 8-in. line. A piece of 12-in. pipe was cut into approximately an 8-ft. length and swaged down at each end by heating with a welding torch and driving until one end would weld nicely into the 8 in. steam line.

On the opposite end a Dresser sleeve of 8 in. diameter was fitted by cutting it in half and welding one of these sections to the end of the 12 in. pipe. The bolts used to tighten the packing clamp, or ring, were square-headed of the same size as those originally supplied with the purchased fitting.

The nuts into which these bolts screwed were welded to the 12 in. "sleeve" just back of the swaged end. In this way it was possible to tighten the packing ring uniformly by means of an ordinary crescent, or open end wrench.

The main line itself was moved into the sleeve so that approximately 8 to 10 in. of expansion was provided for; after which the packing ring was tightened until leaking stopped, although still permitting the pipe to slip back and forth in contraction and expansion.

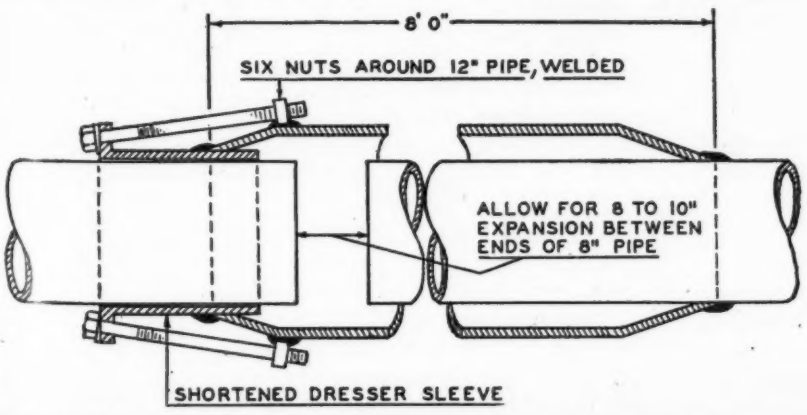

Fig. 3—Partial cross-section view of special expansion joint in steam line at Texas Gulf Coast refinery

Test Tube Bundles for Leakage With Vacuum Pump and Gage

TUBES in exchanger and cooler bundles are quickly and positively checked for pinhole leakage at Socony-Vacuum Oil Co.'s East Chicago refinery by means of a simple method worked out by the plant process department. After heads have been removed, a rubber stopper is inserted tightly in one end of a tube. In the other end a one-holed rubber stopper is placed. A ⅛ inch pipe inserted in the hole of this stopper is hooked up to a small vacuum pump and a gage. Any leaking tube can then be easily spotted and replaced.

Cleaning Tube Bundles

Have you worked out a successful method for cleaning tube bundles without removing them from their installations? Plant maintenance men in refineries all over the country to whom we've talked tell us they would give their eye tooth for a good way to handle this problem. They want to cut downtime at every chance.

If you do have a method you like, write it up and send it in —with drawings and photographs, if possible. PETROLEUM PROCESSING will pay at the usual space rates for all material accepted and published. Don't worry about "editorial style". We'll dress up the descriptions and illustrations. Send your contributions to:

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Laboratory Still Features Two Safety Devices For Handling Atmospheric or Vacuum Operations

LABORATORY stills for crude distillation or for separating cuts of various crude fractions are featured at two of Humble Oil & Refining Co.'s Baytown refinery laboratories. They permit both vacuum or atmospheric pressure distillation and embody several unusual ideas of construction and safety.

One of the permanent distillation set-ups—there are three in use— is shown in Fig. 1. The still-pot is made of two 8-in. pipe welding caps, welded to a 3-in. length of 8-in. diameter pipe. This pot is threaded at one end to take a 10-in. length of 2-in. pipe, which in turn carries a flange arrangement fitted with a gasket on the unthreaded end. The column proper is all-Pyrex glass, and is held against the gasket or the metal flange by springs, or "leashes."

The glass portion of the column is a section of 50 mm. Pyrex tubing to one end of which the neck from a conventional 51 mm. "balloon" has been sealed. The neck rim is flat-ground to make good contact with the gasket in the glass-to-metal oil-sealed joint. The other end carries a conventional ground-glass joint, or it may be sealed to the usual still-head.

The column is packed over most of its length and down into the steel portion for a total of 42 in. with Fenske-type packing, consisting of 3/16 in. stainless steel helices. External insulation is asbestos, and carries a resistance wire winding controlled by a variable voltage transformer to aid in maintaining column temperature.

One arm of the column head carries a thermometer and the other a stainless steel (or copper) reflux condenser cooled with ice water, or an alcohol-dry ice mixture. Stainless steel is preferred by Humble for "sour" crudes.

Overhead make is taken through a tube carrying a stopcock and the male end of a standard Pyrex spherical joint. Between this joint and the stopcock is inserted a pressure-relief line from the distillation head. A second line, leading to a water-trap or other convenient means of venting excessive pressure, is also connected at this point.

The condenser proper may be of glass or stainless steel. The latter is used at Baytown in this application because sulfur-bearing crudes and products are frequently run in this apparatus.

The receiver train is Pyrex glass, arranged as shown to permit removal of the sample at any time at atmospheric or reduced pressure without disturbing the distillation itself. The product receiver is a large glass cylinder (or graduated cylinder) since quantities of particular fractions are generally large.

There are two safety features worthy of note. The first is the vent line from the distillation head to the condenser side of the stopcock in the overhead take-off line, Fig. 1. This prevents blowing up the column in the event the take-off line should be closed off or plugged. Ordinarily, it will take care of pressure surges resulting from mild "bumping" during distillation.

The second feature removes a fire hazard which might occur should the first device fail or a violent pressure surge develop which would blow off the cork stopper carrying the thermometer. Not infrequently such an occurrence would carry some liquid with it, which might run back down the column on the outside and into the burner below.

The device is shown in detail in Fig. 2. It consists of a plug cock in an air line, which when opened will snuff out the burner. A spring is connected to one side of the arm on the plug, tending to move it to the wide-open position. A rod is connected to the other side. When the cock is in the closed position, one end of the rod will be positioned just above the cork in the still-head carrying the thermometer; it rests on a knife-edge. Should the cork blow out, the rod will be knocked away from the knife-edge and the spring will promptly open the cock, instantly snuffing the burner.

Good to 2 mm. Hg. Pressure

The distillation arrangement described is satisfactory for pressures from atmospheric to as low as 2 mm. Hg. absolute, and has been run at temperatures as high as 550° F., top-head, at atmospheric pressures. It will distill any product from crude through the gas oils.

The whole arrangement is mounted in a tray made from boiler plate, the edges of which will confine a layer of liquid to 2 in. in depth. The pot and lower portion of the column are enclosed in a sheet-iron shield, perforated at the bottom edge to admit air to the burner, and carrying a door for the convenience of the operator. Pot, column, and all glassware are supported on ¼-in. steel pipe, screwed and welded into one integral framework.

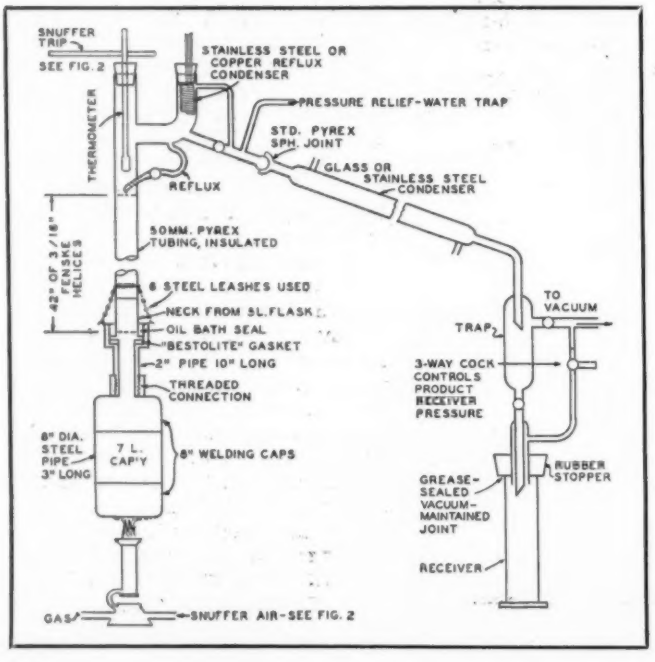


Fig. 1—Left: diagram for a laboratory crude distillation arrangement, satisfactory for temperatures to 550° F. and pressures from atmospheric to 2 mm. Hg. ab.

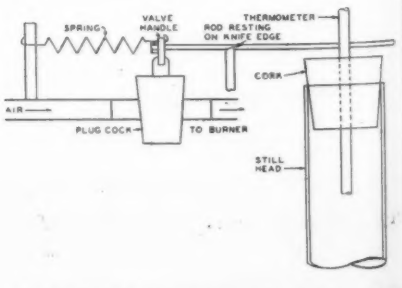
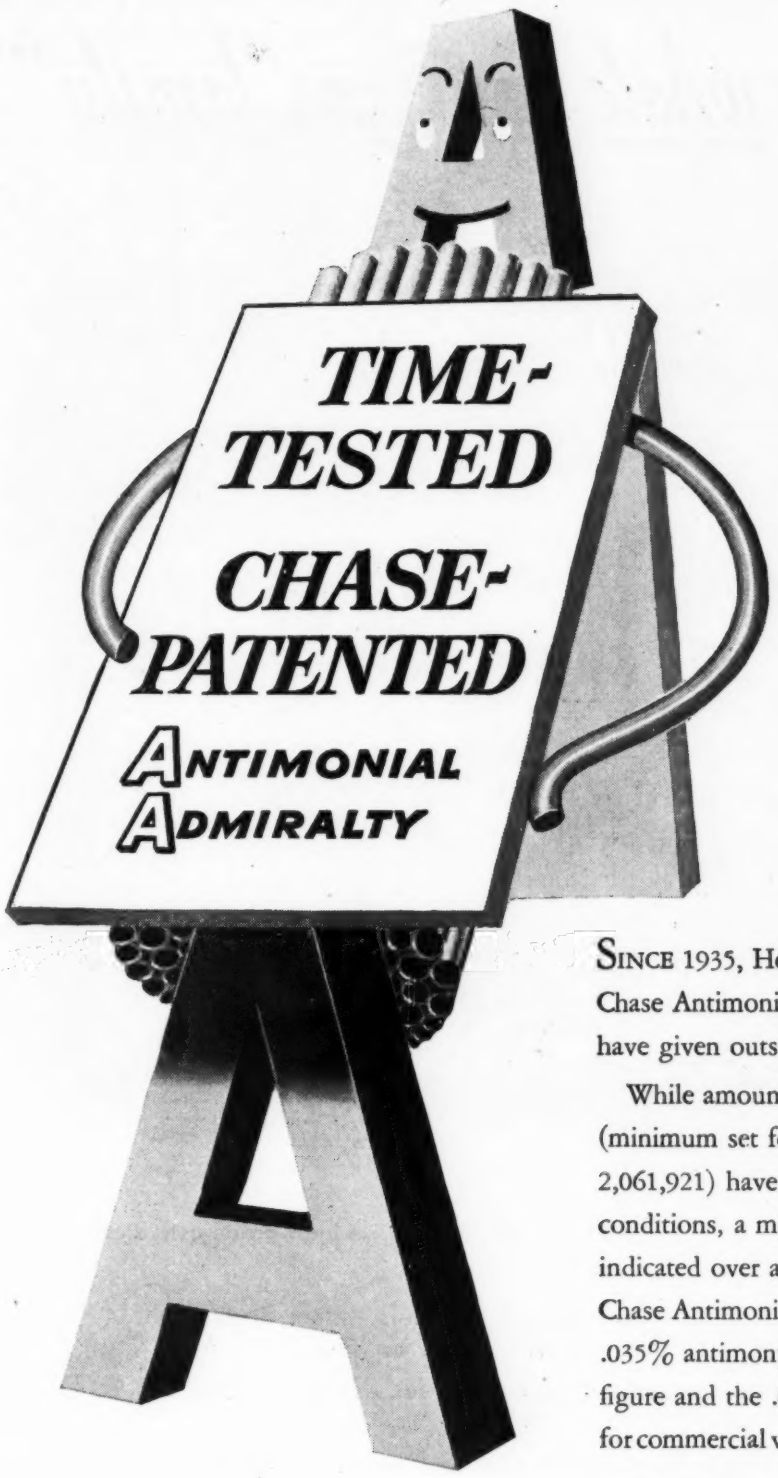


Fig. 2—Right: Detail of safety device for snuffing burner in the event of severe pressure surge which might spew hazardous sample from still



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Heavy coating of algae on cooling tower slats before treatment with liquid bromine

After bromine treatment, slats are almost free of clinging growth, with dead flakes accumulated at bottom

Liquid Bromine Removes Obstinate Algae From 10,000 gpm Tower for $2.10/day

By JOHN C. ALBRIGHT

A TROUBLESOME and obstinate growth of algae which had infested the 10,000 gpm. cooling tower at Wilmington Gasoline Co.'s natural gasoline plant on Terminal Island in the Long Beach, Calif., harbor area is now being removed by treatment with liquid bromine at the rate of 10 lbs./day.

With bromine quoted on the current market at about 21¢/lb., operating charges for the treatment are about $2.10 daily. Initial cost of the treating apparatus was not over $35.00. It consists of an aspirator connection between a drum of bromine and the cooling tower water basin. Company said a less expensive applicator can be purchased for about $18.00.

Bromine Three Times More Effective

Tests at Wilmington's plant have indicated that, pound for pound, bromine will remove and keep under control about three times the quantity of algae that chlorine will. Operating cost with chlorine at about 9¢/lb. would therefore be approximately $2.70/day for the required 30 lbs. of chemical.

The current price, installed, of a typical commercial chlorinator of 50 lbs./day capacity is $3300. The difference between the costs of the two types of applicators can be used to buy about 7¾ tons of liquid bromine. At a consumption of 10 lbs./day, that would be sufficient for 4¼ years of algae control at Terminal Island.

For the introduction of bromine into the water basin, a water-actuated aspirator is employed, which fits into a flanged plate on the bung of the steel, lead-lined container. Water pressure to operate the aspirator is taken from a convenient line from the circulating pumps on the cooling tower. Water-saturated bromine flows from the aspirator outlet through polyethylene tubing. A single stopcock regulates the flow.

During the test phase when the bromine treatment program was first begun, introduction rate was adjusted so that there would be a residual bromine content of 5 parts/million. It was found that this would quickly kill the accumulation of algae growing on the louvres, breaker decks, piping, and headers.

This rate was started as a so-called "janitorial service" rather than shut down the plant to clean the structure manually with water jets and scrapers. Treatment was performed during the 8-hour daylight shift so that the operator controlling the application could observe its effects. Company was interested in learning what period of the day was most favorable, depending on water and atmospheric temperatures.

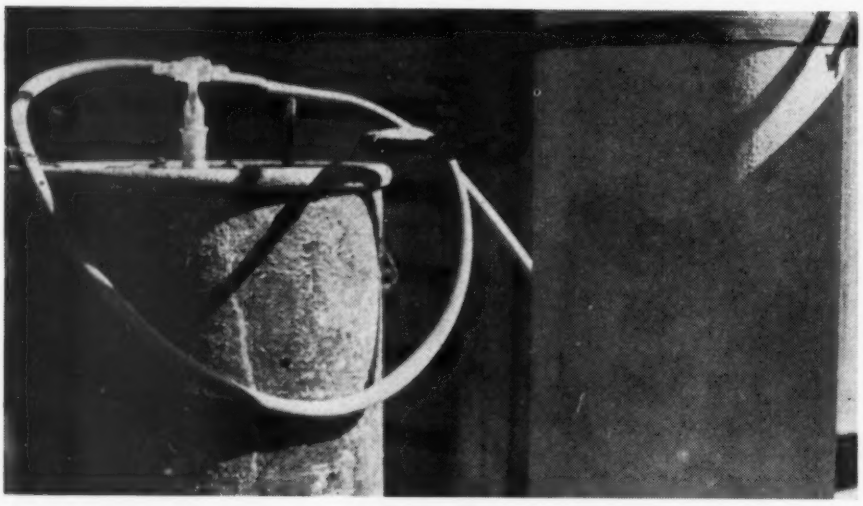
The introduction rate was steadily reduced until the residual bromine content dropped to 2 ppm. The time for "slugging"—adding the definite quantity of bromine—dropped to about 15 minute/day, usually during the afternoon. At that time the temperatures were highest and the algae growth most flourishing.

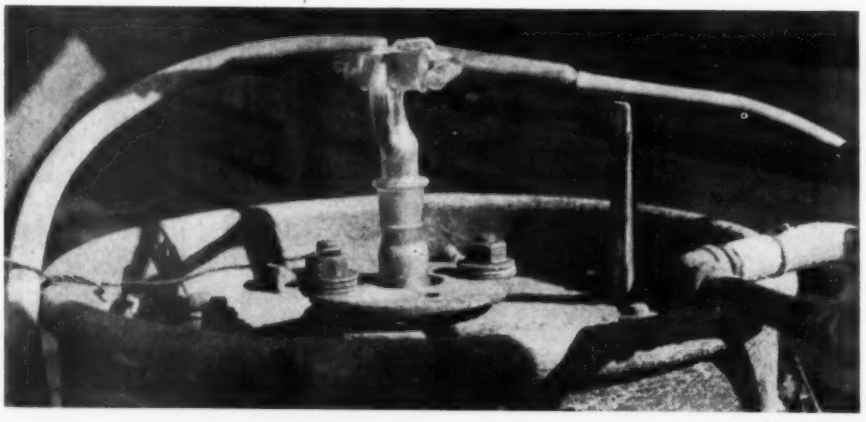
The Wilmington cooling tower circulates about 14,400,000 gals. of water per day. Make-up averages 120,000 gals./day. At the time bromine treatment was initiated, this cooling tower handled all of the heat load of the plant, including a two-stage gas compression, absorption oil to process around 50,000,000 cu. ft. of field gas, and a closed jacket water system for the engines and compressors, all of which produced conditions and temperatures ideally suited for the rapid propagation of the algae.

Purchased in 200-lb. Drums

Bromine is purchased from American Potash and Chemical Corp. It is produced at that company's plant at Searles Lake near Trona, Calif., and shipped to consumers in lead-lined steel drums containing 200 lbs. of the chemical. One drum lasts almost three weeks at the Terminal Island gasoline plant.

As the algae is killed, it releases its hold on the tower structure and accumulates in the basin. It should





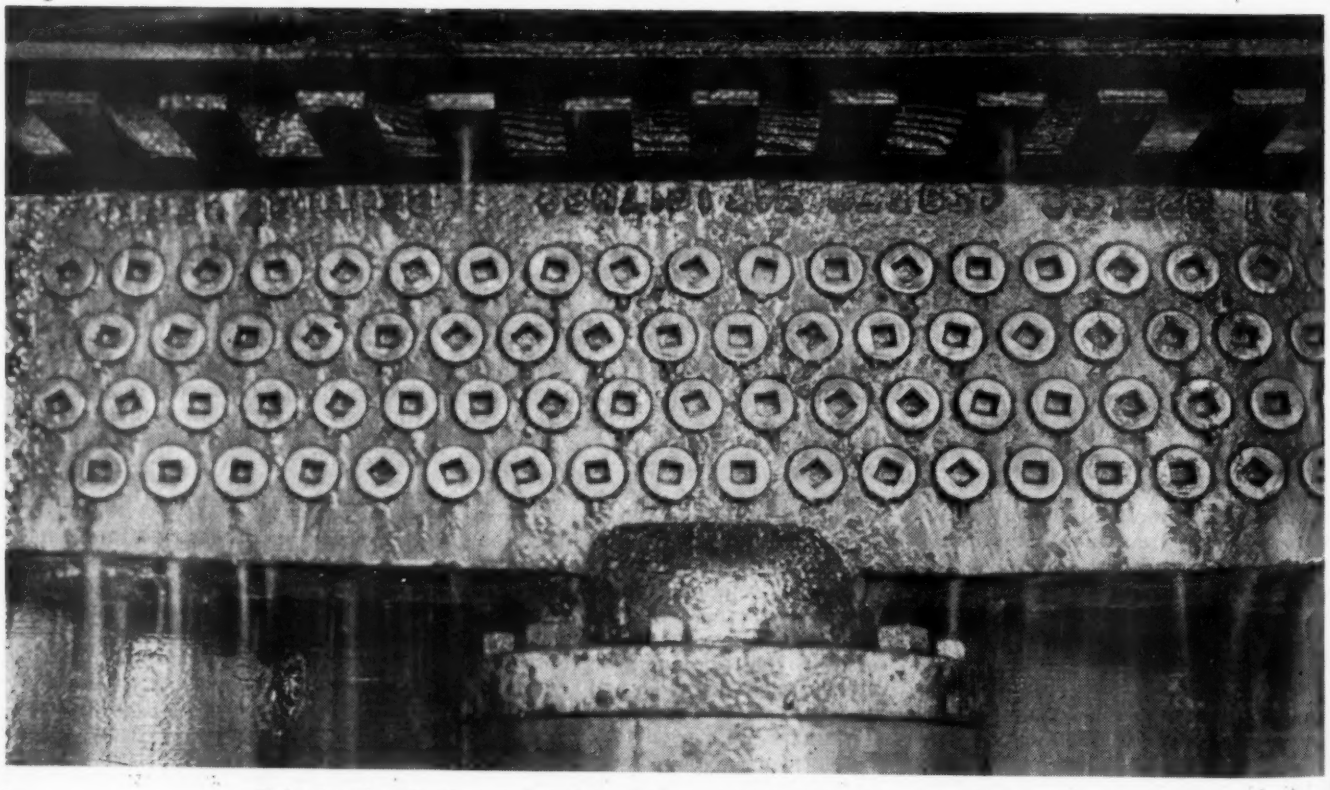
Above: Bromine drum with water-actuated aspirator connected to plant water line. Below: Close-up view of aspirator showing method of connection to bromine drum

be removed as rapidly as possible, because the dead plant absorbs as much bromine as the live one. The usual method is to open the sluice gates of the basin and wash the mass away with a stream of water under pressure. Otherwise, a suction hose fitted with a wide flat intake nozzle can be pulled back and forth along the floor of the basin, an operation similar to cleaning a common rain-water cistern.

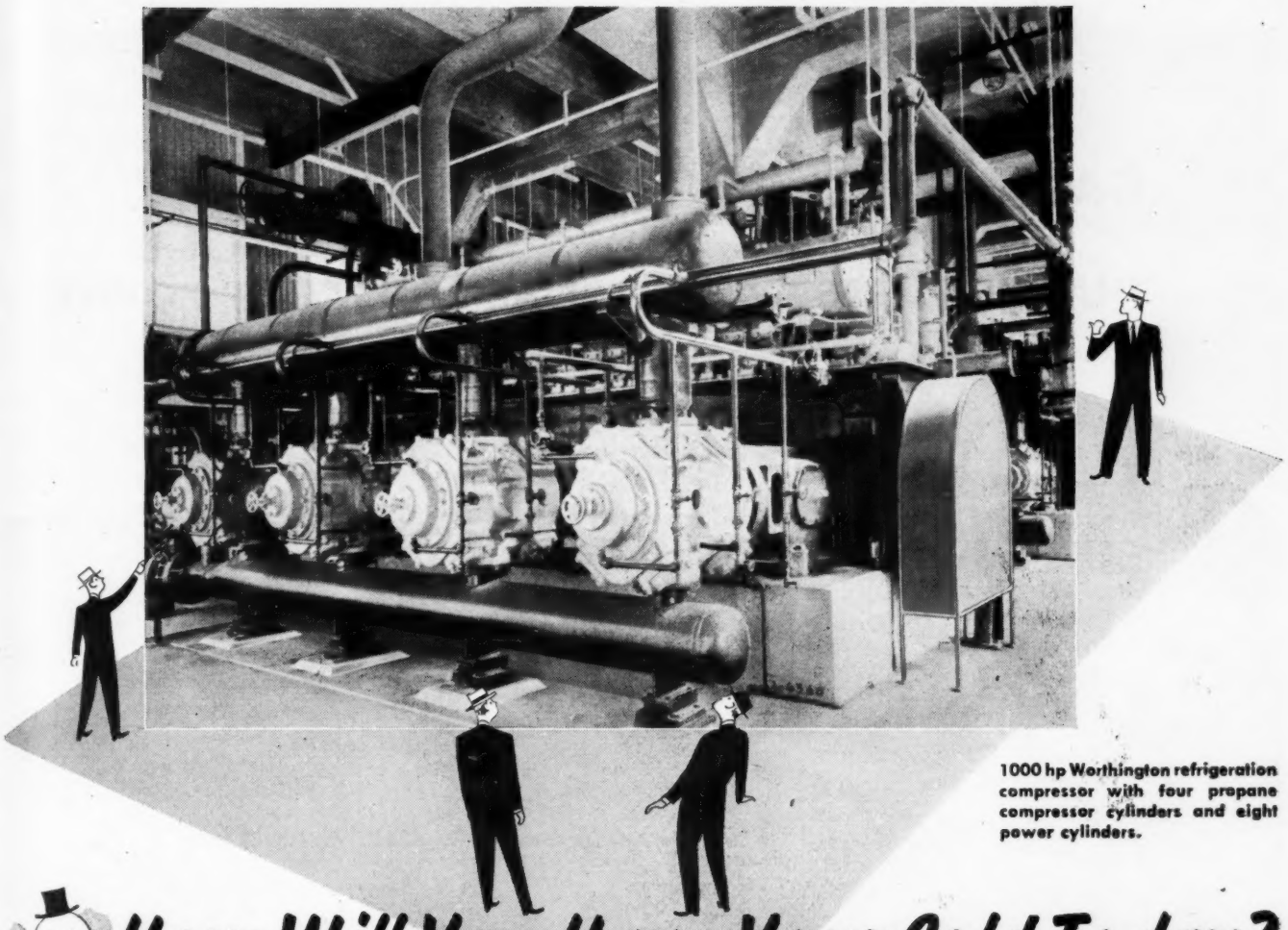
The toxicity of bromine requires certain precautions in its handling. At Wilmington's plant, a container of sodium thiosulfate is kept handy so that the operator can neutralize its action should it come in contact with his bare skin. It is acidic in nature, and any basic salt, such as sodium bicarbonate for example, is recommended for treatment of burns.

Bromine also gives off poisonous suffocating vapors at ordinary temperatures. If it is inhaled, recommended practice for treatment is similar to that for phosgene. Absolute rest is emphasized even in moderate cases, along with inhalation of oxygen.

Chief danger from the chemical occurs during changing of drums, about once very three weeks. The open-air location of the aspirating equipment minimizes to some extent the inhalation hazards. However, workmen must be careful when removing the aspirator from the bung hole and avoid possible drippage of entrapped liquid on their exposed skin.



Tube header showing surface free of algae, residue having been washed away



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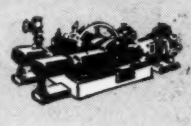
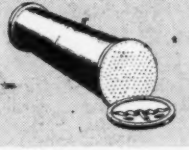
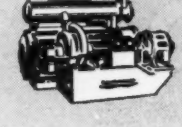


Shell and tube refrigerating equipment



Centrifugal compressors



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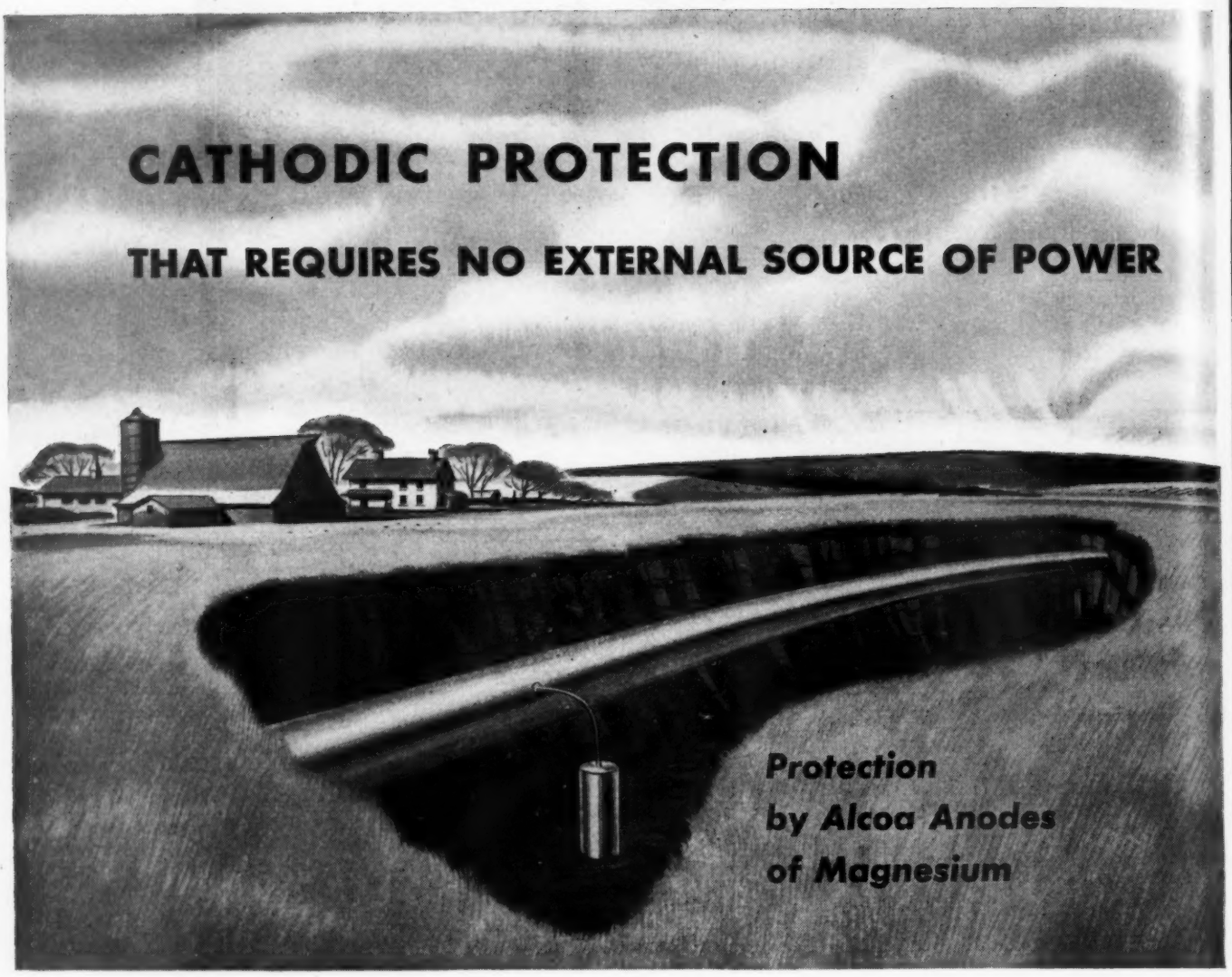

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APPRAISAL OF

Gas Synthesis Operations

A Report to the W.P.R.A.

By R. C. ALDEN and ALFRED CLARK
Phillips Petroleum Co., Research Department

Our potential petroleum reserves are such that the building up of an industry substituting coal or other new materials for liquid and gaseous fuels should be developed over a long period of years to provide the time for the necessary technological improvements. Synthesis processes starting with coal and gas are compared as to costs and yields. Natural gas can play an important "transition" role in producing synthetic liquid fuels supplementary to petroleum.

Gas synthesis operations up to several hundred thousand barrels daily can be sustained by our gas reserves, it is concluded, provided the operation can compete economically with processing crude oil, and that it can pay a price for gas sufficently high to stimulate new discoveries. While the production of liquid fuels from gas synthesis would be only a small percentage of total demand, the synthesis plants would provide excessive quantities of chemicals, based on current market requirements.

AS WAS the case after World War I there is, following World War II, a great deal of concern over our future liquid fuel supplies. This concern was and is based on two major considerations (1) military preparedness and (2) long term public interest. The current very critical supply-demand situation is also of considerable effect.

As a result of recommendations made by various government agencies there has been much public discussion in recent weeks of synthetic or substitute liquid fuels. There no doubt has been so much public discussion that little has been left for the present authors to discuss.

As to the long term public interest in liquid and gaseous fuels it can be said with much pride that the petroleum industry has demonstrated its competence both in regard to its achievements in supplying the public with these important commodities and in regard to its cooperation with those government agencies charged with the responsibility of safeguarding the public interest in respect to liquid and gaseous fuels.

It is a noteworthy fact that, after an interruption caused by the war, the petroleum industry has focused a considerable proportion of its great research and development energy on the problem of synthetic fuel production. It is quite probable that more is now being spent on this one problem by the petroleum industry than was being spent on catalytic oil cracking 10 years ago. In addition there is a very large government research and development program on the longer term aspects being carried out under the Synthetic Liquid Fuels Act of April 5, 1944.

Not only are research and development going on apace but at least two large plants are being built embodying the most immediate economic route to synthetic liquid fuels. The companies carrying on these farsighted activities typify the progressive attitude of the petroleum industry at large. With such an attitude it is to be expected the petroleum industry will continue as the supplier of liquid fuels and the chief supplier of gaseous fuels regardless of the raw materials from which these vital commodities are made.

Energy Resources

The entire question of energy resources is most complex. Omitting consideration of water power and electrical energy and limiting the field to fuel resources and uses the question is still very complex.

On the resources side of the fuels question the various estimates of the thermal value, in terms of our known petroleum (crude oil and natural gas) reserves as unity, place the oil shale, tar sands and coal reserves at about 1.7, 4.6 and 250 respectively. Everyone knows, or should know, that our so-called petroleum reserves are "blue chip" inventories rather than speculative potentialities. Thus for every barrel of crude oil produced or producible there are probably 1 to 2 bbls. of "unrecoverable" oil.

It is entirely reasonable to anticipate that future improvement in production methods, the further application of the more modern production methods and a more favorable price situation will put more and more of this "unrecoverable oil" into the "known crude oil reserves." Further, as the value of natural gas at the well increases it is reasonable to expect that gas reserves will be found at an increasing rate as has already occurred in the Appalachian fields where in the state of West Virginia 5 tons of natural gas have been produced for every ton of crude oil.

Few are bold enough to predict how much more crude oil will be added to our reserves stockpiles by the discovery of new deposits but the most optimistic are of the opinion this may be two times as much as already discovered. We cannot be so optimistic. Nevertheless we can conclude that our potential petroleum reserves are at least 5 times as great as would be concluded from our "known reserves" and may be almost 15 times as great. The important effect of these considerations is that we should be thinking of 60 to 200 years, instead of 13 years, as the period when we will really have exhausted our petroleum.

These speculative considerations also change the ratios of the reserves of substitute fuels from 1.7, 4.6 and 250 to about 0.2, 0.5 and 25.

Another significant consideration is that the substitute fuels require more energy for their reduction to useful products than do crude oil and natural gas. According to our present technologies a fair average is that more than 50% of the energy of the substitute fuels is required to reduce them to liquid products possessing suitable form and place utility. This, of course, has the net effect of halving the ratios again.

One could make the situation still more complex by introducing the subjects of nuclear energy, crops, winds, tides and the sun as energy sources but these are far more speculative than even some of the cobwebs that are being spun about synthetic fuels.

It should, however, be fairly obvious that (1) we have at least 60 years in which to do something about substitute raw materials for liquid and gaseous fuels, and (2) the conversion of fuel resources from their native state, solid, liquid or gaseous, is in itself an expenditure of those very resources and only to be undertaken when there is a compelling reason.

Limiting the discussion to the subject at hand, namely the question of converting natural gas to liquid fuels, we are confronted with the fact that natural gas itself is an ideal fuel for practically every stationary use. There are many who question the economic wisdom of diverting this ideal fuel from the stationary uses to the mobile uses by converting it to synthetic liquid fuels at the expense of half its energy content. We do not propose to answer this question except to inject the thought that place and form utility are extremely important economic factors.

A striking example of the powerful influence of form utility as between gaseous and liquid fuels is to be found in the oil refining industry where hundreds of million of dollars were spent on converting isobutane with a clear octane number of 100 to alkylate with a clear octane number of 90-95. All that was done in this case was to change gaseous butane to liquid alkylate at a considerable expense of energy and with some loss in yield and in the most important anti-knock quality.

With these thoughts in mind it can be stated that the aggressive development of the gas synthesis operations can perform the very useful function of putting at least some of our natural gas into the mobile use markets and that either these markets or the stationary use markets will serve to set the economic price cellar for the other.

American vs. German Processes

The original process as applied commercially in Germany falls far short of the American developments. Although the German technologists prior to the recent war pointed the way in pilot plant operation for improved processes, the large scale designs were "frozen" in the early part of the war as a part of their national emergency program. The American version of the Fischer-Tropsch process, the version with which we are concerned here, differs drastically from the German version—yet in principle they are similar.

In both processes, the primary step is the production of synthesis gas, similar in composition to water gas. In the German commercial process, synthesis gas was made from low grade coal or coke in conventional water gas sets. In the American version, it is planned in the first commercial ventures to make synthesis gas from natural gas by partial oxidation at high temperature with relatively pure oxygen (approximately 95%).

The installations for producing oxygen will be much larger than any previous installations and will incorporate many improvements made possible by large scale application and in part developed during the war. The cost of this oxygen will be considerably less than any previous costs. The exact cost is still a subject of considerable engineering analysis. The partial combustion of natural gas with oxygen in any event is an extremely rapid reaction requiring far less equipment than when coal is the raw material as in the conventional water gas sets employed by the Germans.

The next step, in which synthesis gas is converted to liquid hydrocarbons, also differs drastically between the two versions. The German version employed a pelleted or granular cobalt-thoria catalyst placed in numerous small, complicated reactors containing a tremendous area of cooling surface to remove the very large exothermic heat of reaction. In the American version a fluidized, inexpensive iron catalyst will be employed which requires far less cooling surface to extract the heat of reaction from the reaction zone.

In both processes, a hydrocarbon product, a synthetic crude oil, is obtained which after suitable refining gives in the American version a high (80) octane number gasoline compared to a poor quality (35 octane number) gasoline from the German version. An aqueous product is also obtained in both versions from which various important chemicals may be recovered.

Experimental work is now going on in this country aimed at cheaper and more efficient methods of producing synthesis gas from coal which may be utilized in the gas synthesis process. In this experimental process, powdered coal in a fluidized condition is treated in a reactor continuously with steam and oxygen. The process has many potential advantages over the conventional intermittent water gas process.

Engineering Aspects

In Table 1, engineering data starting from coal and gas are summarized. The investments required for a given production vary considerably depending on whether coal or natural gas is used as the starting material. Using coal as a raw material, plants are estimated to cost approximately $8000[2] per daily bbl. of production. Using natural gas, costs are variously estimated at $3000[3] to $4000[4] per bbl per day. In order to produce 650,000 b/d of product from coal an investment of 5.2 billion dollars would be required, compared to approximately 2.6 billion dollars starting with natural gas.

Although investment and processing costs are higher with natural gas synthesis than with crude oil refining[5], raw material costs have been less, and the two factors have a tendency to balance out. It is now generally believed that gasoline produced from natural gas at prevailing prices is approaching economic competition with that produced from crude petroleum. A survey[6] made last spring, for example, indicated that gasoline from natural gas under these conditions could be made available at less than 3¢ per gal. over the cost from crude petroleum. Gasoline from coal via the Fischer-Tropsch process it was indicated could be made available at an increased cost of 4-9¢ per gal. The cost, of course, varies with the raw-material prices.

TABLE I—Summary of Basic Data on the Gas Synthesis Process

	Gas	Coal
Raw Material per bbl. of Motor Fuel Produced	10,000 cf[7]	1360 lbs[8]
Fuel Value (Therms) of Raw Material per bbl. Produced	100	163
Thermal Efficiency (%)	50.1	31.0
Investment ($/B/D)[a]	$3000-$4000	$8000
Tons of Steel per B/D	6.1[9]	8.7[9]-12.0[10]
Mfg. Cost per Gallon (¢)[d]	7.7-9.7[b]	11.4-16.4[c]
Overall Aspects of 650,000 B/D Production:		
Investment	$2,600,000,000	$5,200,000,000
Tons of Steel Required	3,960,000	5,650,000-7,800,000
Natural Gas (MM CF/D)	6,500	.....
Coal (T/D)	.....	440,000
Natural Gas Reserves for 20 yrs' Operation (Trillions of CF)	47.5	.....
Coal Reserves for 20 yrs' Operation (Millions of Tons)	.....	2920

(a) Battery limit estimates (excludes by-product investment)
(b) Before taxes
(c) Before taxes, coal at $3.00/ton
(d) A sample calculation of costs on the gas synthesis operation is as follows:

	Per Gal.
Natural Gas at 10¢ per M	$0.0238
Operating Costs	
Labor, Supervision, Technical Administration, Sales	0.0290
Maintenance, Supplies, Utilities	0.0200
Amortization (20 years)	0.0131
Interest (4%)	0.0055
Total	$0.0914

No provision for investment nor credits for by-products such as natural gasoline, liquefied petroleum gas and chemicals.

For example, for every increase of cost of gas of 5¢/Mcf or of $0.74 per ton of coal, 50¢ per bbl. is added to the cost of the product.

A recent estimate by Murphree (*Oil & Gas Journal*, March 4, 1948, page 38) is quoted as follows: "Based on going prices of $2.78 per bbl. for crude and 10¢ per thousand cu. ft. for natural gas and estimates of $3.20 per ton for coal and $1.00 per ton for shale, and allowing 5% for amortization and 10% for return on investment all along the line, gasoline from crude, allowing credit for by-products and including product transportation, costs 14.1¢ per gal., as against 12.8¢ for gasoline from natural gas, 16.6¢ from coal and 16¢ from shale. The figures are based on a gasoline with an octane number level to satisfy a 10 to 1 compression ratio engine capable of giving about 30% more miles per gallon than present engines, which it is believed will be required by the time there is any large synthetics production."

Included in Table 1 are some of the elements of cost of gas synthesis gasoline based on published statements pertaining to the basic features of costs such as investments and yields.

To give some idea of the tremendous quantities of steel required, the following comparisons are made: To produce a bbl. of oil from a new field and a new refinery in the U. S., approximately 3.2 tons of steel[9] are required, 4.2 tons per daily bbl. of oil from shale[9], 6.1 tons per daily bbl. of oil from natural gas and 8.7-12.0 tons starting with coal. In order to produce 650,000 b/d of oil by the gas synthesis process using natural gas, about 3.9 million tons of steel would be required or 5% of the total steel production in 1945. Using coal, about 5.6-7.8 million tons of steel would be required, or 7.1-9.9% of the 1945 steel production.

From the standpoint of yields, coal is a less efficient raw material for the gas synthesis process than natural gas. The thermal efficiency starting with natural gas is considerably higher than that starting with coal, 31% compared to 50%. The coal consumption for the production of 650,000 b/d of liquid fuels would be approximately 160 million tons per year or about 28% of the 1945 figure for coal production in the U. S. The use of this process would require considerable extension to our present coal mining facilities.

It should be pointed out that shifting the raw material source for motor fuel supply represents a tremendous undertaking with vast expenditures of money. It would, therefore, appear to be advisable to develop this production soundly over a period of years. Proceeding in this manner would permit the incorporation of new developments into plant designs leading to reduced investments.

Because of the low thermal efficiencies of gas-to-liquid fuels and coal-to-liquid fuels processes, their use in this manner cannot be considered as ideal conservation measures unless the form-utility, i.e. the value of the fuel in the liquid state, is of sufficient economic utility to justify.

The present status of developments for utilization of coal and natural gas for the production of liquid fuels has been mentioned briefly hitherto. The natural gas conversion process is now ready for commercial exploitation. Two plants, the Stanolind plant in the Hugoton field, Kans. and the Carthage Hydrocol one at Brownsville, Texas, are now under construction. The coal conversion process is still in the development stage in this country. The following companies are engaged in this work: The Texas Co., Shell organization, Jersey Standard organization, Pittsburgh Consolidation Coal Co., and Hydrocol[11]. There is a report[11] that engineering work is in progress on a coal-to-liquid fuels plant for Anglo-Transvaal, a mining company, to be built near Johannesburg, South Africa. It is stated that this plant will have an output of about 7500 b/d but will probably not be completed for about 3 years.

A Factor in Conservation

Since the Fischer-Tropsch process is potentially applicable not only to the production of liquid fuels from natural gas but also from coal, it will be interesting to compare the reserves of coal and natural gas available with the present crude oil reserves. Gas reserves are currently estimated at 165.9[12] trillion cu. ft. and reserves of total liquid hydrocarbons at close to 25[12] billion bbls. In order to convert the gas reserves to an equivalent energy basis, the standard fuel-oil-equivalent figure, 6,000,000 BTU equals 1 bbl. of fuel oil may be used, and the natural gas may be considered to be equivalent to 1000 BTU per cu. ft. On this basis, the natural gas reserves are calculated to be equivalent to 27.6 billion bbls. of fuel oil. The danger, of course, in such a calculation, is that efficiencies of conversion of gross heat into useful heat by the consumer are neglected. Nevertheless, the comparison is legitimate on the basis of total energy content and shows that on the thermal basis the gas reserves are about 2.6 billion bbls. larger than the crude plus other reserves of approximately 25 billion bbls.

All of this energy in natural gas would not be available if converted into liquid fuels by the gas synthesis process. Approximately 50% of the energy is dissipated in the process. The fuel oil equivalent then of the Fischer-Tropsch liquid products from 165.9 trillion cu. ft. of natural gas is approximately 13.8 billion bbls. About 85% or 11.7 billion bbls. of this product would be gasoline. The forecasted demand for gasoline in 1948 is given as 2,456,520 b/d[13] and at this rate, our natural gas reserves would last for approximately 13 years. The forecasted production of crude in 1948 is given as 5,279,900 b/d[13], which would make the estimated reserves of 25 billion barrels also last approximately 13 years. Therefore, barring a tremendous increase in the rate of discovery of new reserves of gas, it cannot be considered as a long range source of liquid fuel.

Coal, on the other hand, is available in tremendous quantities. The reserves of coal in the U. S. suitable for use in this process amount roughly to 3.2 trillion tons[14], equivalent approximately to 4.7 trillion bbls. of gasoline—a supply sufficient for several thousand years. Therefore, it is obvious that any significant long range liquid fuels program must be based on coal.

Regardless of which carbonaceous raw material will serve as the ultimate long-term source of liquid fuels, natural gas may very well play an important "transition" role. How much of our natural gas reserves can and will be diverted to liquid fuel production is certainly a difficult question to answer. Paramount among the considerations involved is the question of utilizing gas reserves most efficiently from the standpoint of energy delivered to the consumer. The various present uses of natural gas may be classified as follows:

1. Use of natural gas as an agent in the production of crude oil (and condensate).
2. Use of natural gas as a direct fuel (pipe line distribution) and field uses.
3. Use of natural gas for chemicals production, including,
4. Carbon black.

The first three of these uses will undoubtedly take precedence over the use of gas for the Fischer-Tropsch process. The use of natural gas in operations for conserving crude oil reserves is becoming increasingly important and is mandatory, where feasible, in many states. The use of natural gas directly as a fuel is the ideal use from the standpoint of convenience and thermal efficiency. The present rapid expansion of the natural gas industry makes it difficult to classify the picture fully at the moment, but it is believed that the direct uses will usually take economic precedence over gas conversion processes. The amount of natural gas employed in the production of chem-

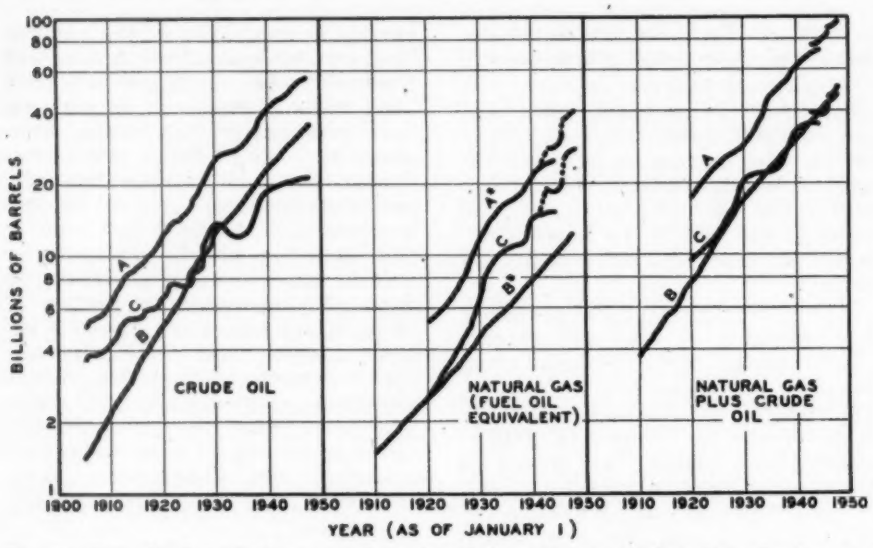

Fig. 1—Growth of natural gas and crude oil discoveries, marketed production and reserves in the U. S. Curve "A" represents cumulative discoveries, curve "B" cumulative marketed production, and curve "C" reserves. *—excluding waste and losses

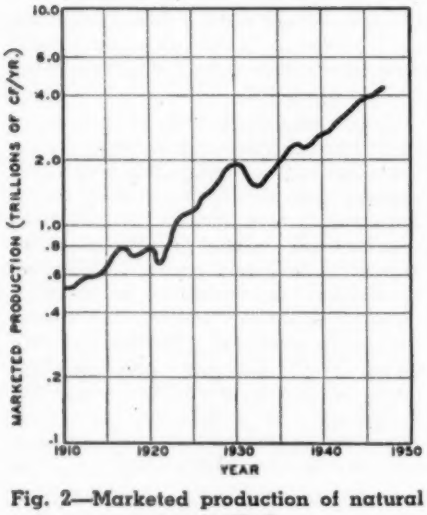

Fig. 2—Marketed production of natural gas in U. S.

icals will no doubt be small in relation to reserves and production and, therefore, unimportant in synthetic fuels considerations. Such uses, however, represent an important and profitable use of natural gas and probably also will take precedence over gas conversion to liquid fuels.

Because of the high energy requirements of the conversion, the production of carbon black from natural gas has supported the lowest market price for natural gas.

Much has been said about the total capacity of gas synthesis production that our natural gas resources can support. The viewpoints range from one extreme to the other. Actually the problem involved is relatively simple if one is a good guesser. One must guess at the amount of new gas reserves yet to be discovered and the future rate of increase (or decrease) in the established uses for natural gas. To assist in making such guesses intelligently the trends in cumulative production, reserves and total discoveries for crude oil[15] and natural gas[16] have been plotted on semi-log graph paper in Fig. 1. Fig. 2 is a similar plot of annual marketed production of natural gas.

Of particular interest are the curves for natural gas. Among other things it may be noted from Fig. 2 that the marketed production of natural gas has doubled every 11 years with great regularity and that the total discoveries of natural gas are increasing at an even more rapid rate. Exclusive of waste and losses of natural gas the total discoveries as of Dec. 31, 1947, had been 240 trillion cu. ft., of which about 74 trillion had been marketed and 166 trillion was in the producing formations. Marketed and "net" production was 4.4 and 5.6 trillion cu. ft. in 1947 and new reserves during the year were 10.9 trillion cu. ft.

So far as available statistics indicate there has not been a year or a period of years when discoveries of gas have not exceeded the year's or period's production including waste and losses and it is to this fact the advocates of large gas synthesis operations point. However, this is not a safe position to assume in a market that has doubled every 11 years. Under this condition the present reserves of 166 trillion cu. ft., and more, will be needed for the already established uses in view of the great investments that have been made for them.

Unless there is some abatement in the rate of increase of the established demands for natural gas ("domestic", "commercial", "refineries", "field", "carbon black", "electric power" and "other industrial") there is little room in our present gas reserve situation for more than a very little gas synthesis operation. In addition to the future of established demands there is the question of future discoveries. Will these be one, two or three times as much discovered as already has been discovered? The trends shown in Fig. 1 are headed for even more astronomical figures. It is reasonable to assume that given the stimulus of new markets and higher field prices much more natural gas will be discovered and marginal uses will be curtailed.

It is a popular pastime to speculate on the future of gas synthesis operations. The formula for the calculation is:

$$Y = \frac{R + ND}{P + 3.65\,G}$$

where

Y = years our gas resources will last,

R = known reserves of natural gas, in trillions,

N = ratio of future to past discoveries,

D = past discoveries, in trillions (cumulated),

P = future average annual marketed production, in trillions,

G = daily production of gas synthesis gasoline, barrels per day times 10^{-6}.

Fig. 3 is a graphical representation of this formula and may be used to calculate the effect of assumed future conditions, within the limits shown, on the years our natural gas supply will last. As an example, Table 2 shows the effect on the life of our natural gas supply of 500,000 b/d of gas synthesis gasoline for several increments of new gas discoveries and of annual marketed production for established uses. Under the conditions assumed the life of our gas reserves is shortened from 15 to 30% at this level of gas synthesis operations. However, even this large reduction is less than the reduction brought about by tripling the demand for established uses. Furthermore a greatly accelerated rate of discovery can almost offset both factors. Thus the assumptions of large new discoveries and of a waning rate of increase in established uses lead to the conclusion that large gas synthesis operations can be maintained. Contrariwise the assumption of waning discoveries and accelerating uses in established markets can lead to the conclusion that no gas synthesis operations can be sustained.

Gas synthesis operations will also be limited to those regions where sufficient reserves are available. Approximately ½ trillion cu. ft. of gas is required to operate one 7000 b/d

TABLE 2—Reduction in Years of Life of Natural Gas Resources Caused by Producing 500,000 B/D of Gas Synthesis Gasoline

Annual Marketed Production (Trillions of CF)	Ratio of New to Past Discoveries[a] 1.0	2.0	3.0	4.0
4	31(101-70)[b]	50(161-111)	68(221-153)	88(281-193)
8	10(51-41)	15(81-66)	21(111-90)	26(141-115)
12	5(34-29)	7(54-47)	10(74-64)	13(94-81)

(a) Past discoveries are 240 trillion cu. ft. made up of 74 trillion to marketed production and 166 trillion to known reserves.

(b) For example, the reduction in life of resources is 31 years from 101 years when no synthetic gasoline is produced to 70 years if 500,000 b/d is made.

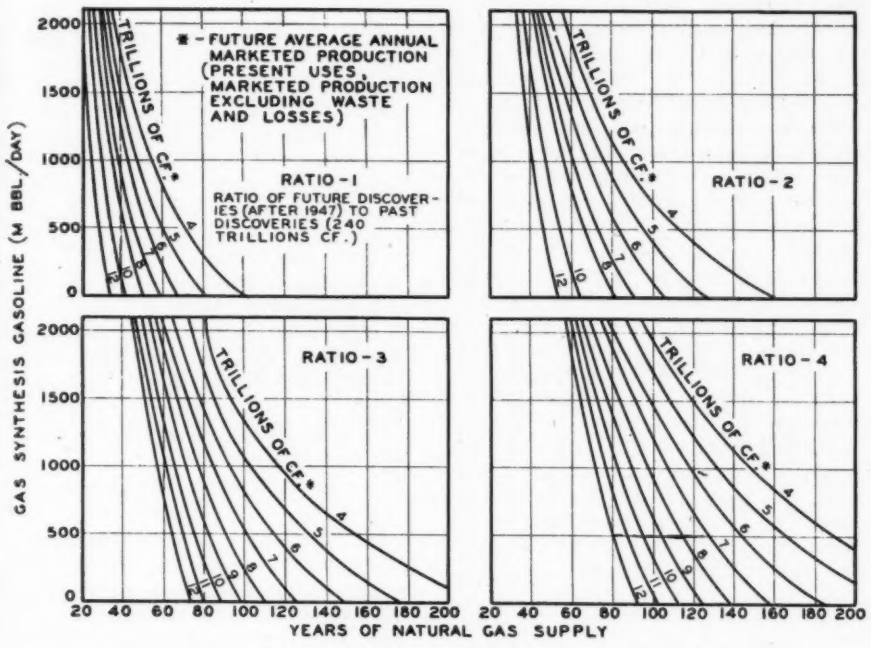
GAS SYNTHESIS GASOLINE (M BBL./DAY)
YEARS OF NATURAL GAS SUPPLY
* - FUTURE AVERAGE ANNUAL MARKETED PRODUCTION (PRESENT USES, MARKETED PRODUCTION EXCLUDING WASTE AND LOSSES)
RATIO - 1
RATIO OF FUTURE DISCOVERIES (AFTER 1947) TO PAST DISCOVERIES (240 TRILLIONS CF.)
RATIO - 2
RATIO - 3
RATIO - 4
TRILLIONS OF CF.*

Fig. 3—Effect of gas synthesis operations on life of gas reserves

plant for a period of 20 years. In Table 3, the gas reserves are listed by states. It may be seen that 10 states contain 98% of the reserves.

Since, at the present time, the gas synthesis process cannot economically stand the expense of a long distance gas gathering system, a further restriction is placed upon the process. It would appear necessary, at least at the present time, to restrict operation to those fields possessing reserves of ½ trillion cu. ft. or greater. In Table 4 the reserves by numbers of fields[17] (in order of decreasing amounts of gas available) are given. In the last column, the average size of fields by increments is given.

It will be observed that out of the total of 426 fields, approximately 50 fields are of sufficient size for the present purpose. These 50 fields contain 72.5% of the total reserves or 114.0 trillion cu. ft., which would be sufficient to produce 1,607,200 b/d of motor fuel by the gas synthesis process for 20 years. However, the reserves of these larger fields are more highly committed to already established uses than are the reserves of the smaller fields.

The net conclusions to be derived from all these considerations is that the future gas synthesis operations up to several hundred thousand bbls. per day could be sustained by our natural gas resources provided (a) that the operation can compete economically with the processing of crude oil and (b) can pay a price sufficiently high for natural gas to stimulate new discoveries. Much will depend on the engineering and economic outcome of the two plants being built and on interim research and development programs. If the design and processing can be further simplified a rather rapid expansion can be anticipated. As things stand, with a marginal long term profit prospect, with a very large investment requirement, and with most important gas reserves committed otherwise, it is quite likely new gas synthesis operations will be undertaken slowly.

Probable Effect of Products

The probable effects which gas synthesis plants would have on gas reserves have been reviewed. The synthesis processes starting with coal and natural gas have been compared from the standpoint of costs and yields. It is also interesting to indicate the effect which the products of such plants might have on existing markets and processes. It is intended here to point out a few of the more practical effects as a function of speculative gas synthesis capacity.

Of all the products of the gas synthesis process, the chemical products have caused the most concern. Their production, though a small percentage of the total liquid production, is a relatively significant figure with respect to U. S. chemical production. The water soluble organic chemicals which may be obtained as by-products from a typical gas synthesis plant of 7000 b/d capacity are given in Table 5. A total of 152,200,000 pounds may be produced per year.

In Table 6 the production from 10 such plants[18], representing 70,000 b/d fuel production, is compared for important chemicals with recent U. S. production figures for those same chemicals. These 10 gas synthesis plants could produce approximately 2/3 of the present U. S. production of these chemicals. The impact on acetic acid would be the greatest. Ten gas synthesis plants would produce substantially the present production of this important chemical. Propionic and butyric acids are also available as shown. Furthermore, the most probable use for propyl alcohol is stated to be for oxidation to the acid. The total acids then from these four sources would be 193 weight per cent of the 1946 U. S. production.

With regard to ethyl alcohol pro-

TABLE 3—Estimated Proved Recoverable Reserves of Natural Gas in the U. S.

(Trillions of Cubic Feet)

Texas	90.0	Mississippi	2.5
Louisiana	23.5	West Virginia	1.8
Kansas	14.6	Kentucky	1.4
Oklahoma	11.4	Wyoming	1.2
California	10.2	Others	3.3
New Mexico	6.0	Total	165.9

TABLE 4—Gas Reserves by Number of Fields (1945)[17]

(In decreasing order of amount of reserves)
(Gas volumes in trillions of standard cubic feet)

No. of Fields	% of Reserves	Amount of Reserves (cumulative)	Amount of Reserves by increments	Avg. Size of Fields (cumulative)	Avg. Size of Fields by increments
		Trillions of standard cubic feet			
5	41.1	64.5	64.5	12.9	12.9
10	51.2	80.4	15.9	8.0	3.2
20	60.3	94.5	14.1	4.7	1.4
30	67.0	105.0	10.5	3.5	1.0
50	72.5	114.0	9.0	2.3	0.45
100	82.2	129.0	15.0	1.3	0.30
426	100	157.0	28.0	0.37	0.08

duction, excluding that which is used as antifreeze, the estimated production from 10 gas synthesis plants would be sufficient to supply the remaining demand. The production of butyl and amyl alcohols is small and would not affect the present production significantly.

With the construction of 50 plants (350,000 b/d total capacity) which according to reliable sources is considered probable within the next 10 years, the 1946 production of ethyl alcohol and acetic acid would be exceeded by 285 and 335% respectively. If these water soluble by-products were not recovered, it would raise serious disposal problems in certain areas. Since these by-products occur in dilute water solutions, they cannot be burned without concentration.

Although 50 such plants would produce excessive quantities of chemicals based on current demands, the production of petroleum products would be only a small percentage of the current demands.

The total average daily demand for 1948 for gasoline is estimated to be 2,457,000 bbls. On the basis that the gas synthesis liquid product is 85% in the motor fuel range, a capacity of 650,000 b/d would supply 550,000 bbls. of gasoline per day or 22% of the forecasted demand for 1948. Using the more conservative prediction of 350,000 b/d capacity starting from natural gas, about 12% of the forecasted demand for gasoline in 1948 would be satisfied. Presumably the gasoline demand will be greater by the time such a large number of gas synthesis plants may have been built.

A few comments should be made with respect to the quality of gasoline obtained by the gas synthesis process. Including polymer gasoline from C_3 and C_4 unsaturates produced in the process, the clear octane rating motor method has been reported to be 80. By the research method, the clear rating is stated to be 92. With the probable use of engines of higher compression ratio, such gasoline becomes increasingly desirable.

With respect to the gas synthesis production of distillate heating oil or Diesel fuel, a capacity of 350,000 b/d would produce approximately 50,000 b/d of this product. This product would have about a 50 cetane number and after hydrogenation would have a cetane number of 75 to 80. The anticipated demand for Diesel fuel in 1948 has been estimated at 221,200 b/d[19]. The above gas synthesis capacity would therefore supply about 22% of this demand. The hydrogenated high cetane number Diesel fuels may find interesting uses in the future for limited demands.

SUMMARY

1. American research and development of the Fischer-Tropsch process has resulted in great improvements which make the gas synthesis operation appear in a favorable light as an economic source of liquid fuels.

2. The gas synthesis operation requires very large investments in the order of $3000-$4000 per bbl. per day on a battery limit basis.

3. The steel requirement of about 6 tons per bbl. per day is so great as to take up to 5% of the nation's 1945 steel production for a capacity of 650,000 b/d.

4. A corresponding production of synthetic liquid fuels from coal would take about twice as much investment and nearly twice as much steel. The coal required would equal 28% of the 1945 production, thus indicating the concomitant requirement of a considerable expansion of coal mining facilities.

5. Natural gas reserves have been increasing at a faster rate than the marketed production of natural gas which has been doubling every eleven years.

6. A producible natural gas reserve of 0.5 trillion cu. ft. is required to sustain a 7000 b/d gas synthesis operation for 20 years with a correspondingly greater reserve for longer operations. In only 10 states are there known gas reserves of over one trillion cu. ft. and only about 50 out of 426 gas producing fields have gas reserves greater than 0.5 trillion cu. ft. It is certain the reserves of the larger gas producing fields are more heavily committed for established uses. Hence, a substantial gas synthesis development must depend on new gas discoveries.

7. Even a comparatively small gas synthesis development will have a profound effect on the markets for the chemical by-products.

8. New gas synthesis plants will be put in at a slow rate until further process improvements are effected. These may be expected from the two plants now being built and from the numerous research and development programs that are in progress.

TABLE 5—Estimated Production of Organic Chemicals from 7000 B/D Gas Synthesis Plant [18]

	Estimated Production Lb/Yr
Acetaldehyde	9,100,000
Propionaldehyde	1,930,000
n-Butyraldhyde	2,750,000
Acetone	11,200,000
Methanol	730,000
Methyl Ethyl Ketone	4,780,000
Ethanol	63,680,000
n-Propyl Alcohol	14,400,000
n-Butyl Alcohol	4,370,000
n-Amyl Alcohol	1,060,000
Acetic Acid	24,700,000
Propionic Acid	8,700,000
Butyric Acid	4,200,000
Methyl Propyl Ketone	600,000
Total	152,200,000

TABLE 6—Production of Important Chemicals by 10 Gas Synthesis Plants of 7000 B/D Capacity Each Compared with U.S. Production[18]

Product	Date	United States (1000 lb)	Ten Gas Synthesis Plants 1000 lb	Ten Gas Synthesis Plants Value[a] (million $)	Ratio Gas Synthesis to U. S. Production
Acetaldehyde	1946	352,000[b]	91,000	7.3	0.26
Acetone	1946	335,000	112,000	6.7	0.33
Ethanol	1943-45	830,000[c]	636,800	40.0[d]	0.77
n-Propyl Alcohol	1946	141,000[e]	144,000	7.2[f]	...
n-Butyl Alcohol	1946	126,000	43,700	5.7	0.35
n-Amyl Alcohol	1946	15,000[g]	10,600	1.2[h]	0.71
Acetic Acid	1946	285,000	247,000	19.8	0.87
Propionic Acid			87,000	7.0[i]	...
Butyric Acid			42,000	3.4[i]	...
Total		2,084,000	1,414,100		0.68

(a) At 1946 prices according to the Preliminary Report of the U. S. Tariff Commission on Synthetic Organic Chemicals for 1946 (Sept. 1947) except where stated.
(b) All figures in this column from the Preliminary Report of the U. S. Tariff Commission except where stated otherwise.
(c) Corrected for allocations to acetaldehyde and acetic acid.
(d) At 40 cents/gal.
(e) Isopropyl alcohol less the percentage used in production of acetone.
(f) At price of isopropyl alcohol, 1945, 5 cents/lb.
(g) Total amyl alcohols.
(h) At price of refined amyl alcohol.
(i) At price of acetic acid.

Acknowledgement

Presented before the annual meeting of the Western Petroleum Refiners Assn., Galveston, Texas, April 7, 1948.

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Color Coding Keeps Loading Safe At Utopia's Truck and Car Racks

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TANK car and truck loading is the object of this month's trip through Utopia Refinery. At our first stop, the truck rack, we notice that loading spouts have been identified by a color code. The loader tells us that each color represents a specific product—red for ethyl gasoline, green for standard, black for fuel oil, and white for kerosene. A good idea—no chance for making a mistake.

We find that the rack is located a safe distance from railroad tracks and the operating area and is well-protected with fire-fighting equipment. In all four corners of the rack we see a hand fire extinguisher, and in addition a fire-resistant blanket enclosed in a metal case has been provided. This blanket comes in mighty handy in case of a clothing fire or for use in extinguishing a dome fire by smothering.

Electric motors serving the rack are all grounded and are explosion-proof type—Class I, Group D. Electric lights are also explosion-proof.

Here comes a truck—let's watch it being loaded. Notice the loader attaches a ground wire to the truck. Looking closer, we learn that the other end of the wire is attached to the piping that connects to the spout. The spout itself is made of non-sparking material, and it is long enough to reach within an inch or two of the bottom of the compartment. This permits filling with a minimum of agitation and splashing which would release excessive amounts of dangerous vapors. This method is known as "submerged filling."

Tracing the line from the rack back to the storage tanks, we note that it is equipped with vent lines. That is to relieve excessive pressures in the line.

Talking to the loader foreman, we learn that the rack is protected by automatic valves which shut off the flow to the rack automatically when excess heat is developed as in the case of fire.

Suddenly the loader spills some product while changing the spout from one compartment to the next. A real Utopian, he immediately stops loading and washes away the spillage. He knows that pools of flammable liquid are nasty to handle should a fire start.

Our next stop is at the light oils tank car rack. Walking down the rack we see that piping, spouts, and the rack itself are bonded at regular intervals as a safeguard against static electricity and stray currents. We also learn that each spur is protected by insulating the joints near the spur entrance.

Facilities for safe crossing from rack to tank cars are provided in the form of drawbridge-type catwalks, each equipped with hand rails.

To prevent objects from falling off the platform of the rack, toeboards about four inches high are installed along each side. At several locations we see a large wooden board serving as a tool rack and containing the required loader's tools, all made of non-sparking metal.

Along the spur itself at the back end is a bumping block to stop tank cars from being run off the end of the track. At the other end, toward the switch, we see a blue flag stop sign warning railroad crews that loading is in progress. In addition, derailers have been placed on the track as a further protection against main line traffic. Along the spur at each loading spot is a drip pan to catch and drain off spillage. A fire wall parallels the spur and is situated between it and the refinery proper as a precaution against spills of major proportions.

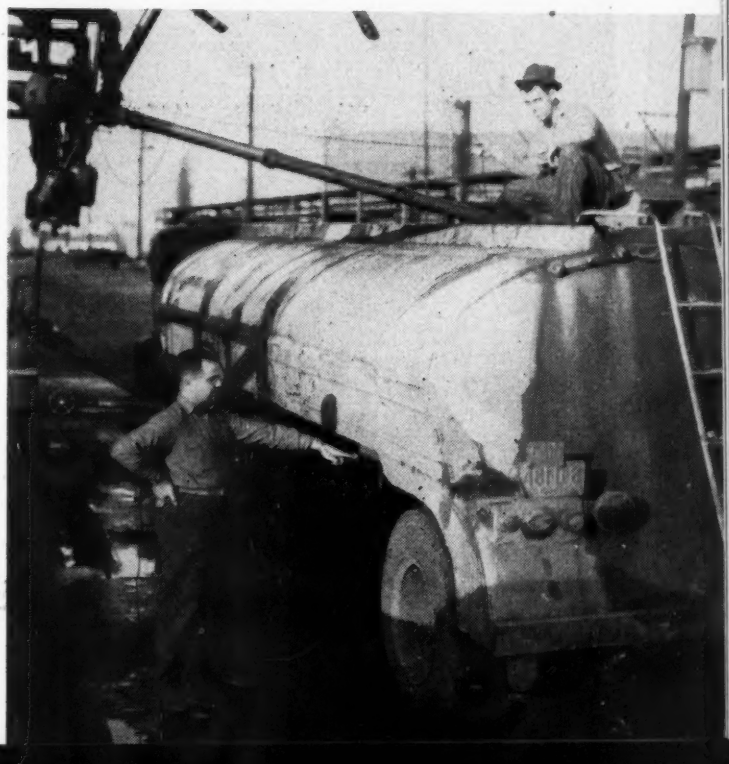
Suppose we take time to watch a loader in action. Notice he has already placed the blue flag stop sign in position and attached the derailers at the incoming end of the spur. Now we see him removing the cap from the valve on the underside of the car. He does this to check on whether the tank car valve leaks during loading operations.

Now he removes the dome cover and inserts the loading spout. We see that this spout is also of sufficient length to reach almost to the bottom of the car—just as with the tank truck loading, it is important to prevent excess vapors from being released because of agitation and splashing.

The loader allows the car to be filled to a point where space still remains so that the product may expand as it will because of external heat. He then removes the spout carefully, replaces the dome cover, and seals it to assure the cargo's being intact when it reaches its destination.

After checking once more for possible leakage at the bottom valve on the car he replaces the cap, and then attaches a placard to the car indicating its contents. The product this time happens to be gasoline, consequently the card reads "Dangerous—Gasoline—Keep Lights and Fires Away. Handle Carefully. This car must not be next to a car containing explosives. Avoid contact with leaking acid or corrosive liquid. Beware of fumes or vapors."

Having observed operations at the light oils rack, we move on to the heavy oil rack, where we find asphalt being loaded into a tank car. The usual precautions are being observed here, but in addition the loader has fastened the spout down to prevent its jumping out of the dome because of pump pulsations. For protection against hot splashes he is wearing heavy gloves, and of course full-length sleeves.



Tank truck loader's first job after truck is spotted is to attach the ground wire from truck to rack. Man on truck can open loading spout valve by means of chain which swings down with spout

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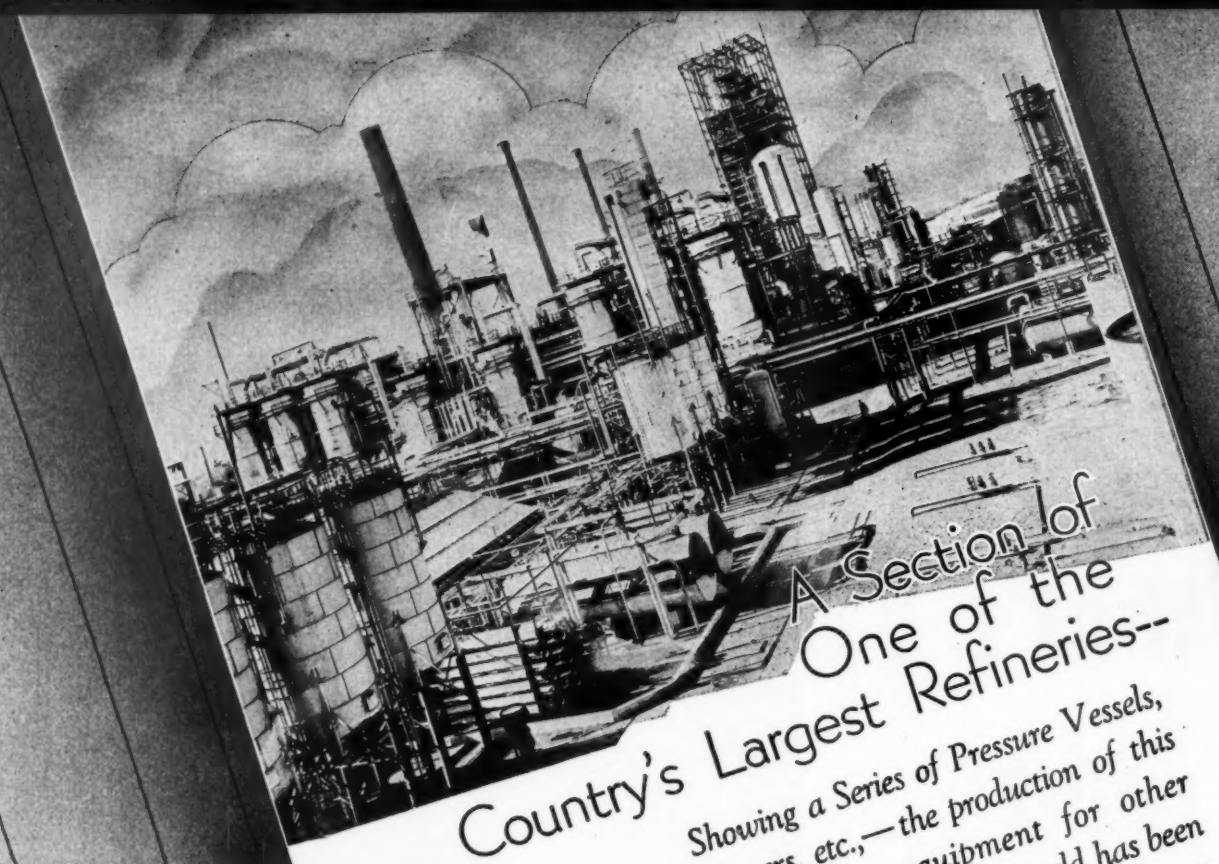

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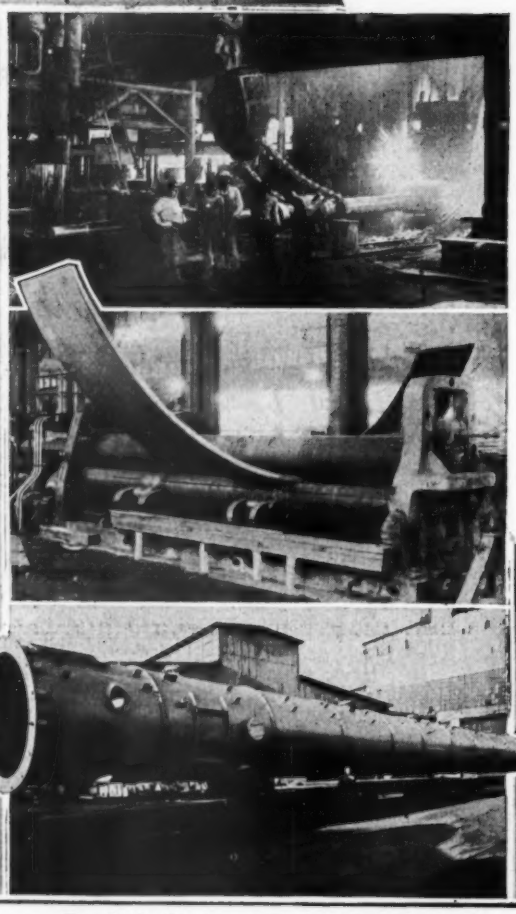

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Regeneration Steps Cut Cost Of Removing Mercaptans

Earlier development work led to the introduction during the war of a catalytic oxidation process for regenerating solutions used in the removal of mercaptans from gasoline. Of a number of catalysts studied for the effective regeneration of treating solutions, it was found that tannins or tannic acid were the most suitable for commercial operations. Studies of variable factors in the rate of oxidation of mercaptans in alkaline treating solutions are presented. A wide variety of hydrocarbon fractions are now being treated by processes using the tannin catalyzed regeneration operation.

THE process for treating gasolines which combines mercaptan removal with regeneration of the treating solution by air blowing, in the presence of an oxidation catalyst such as tannic acid, has been further developed since its first commercial application during the war. As of the latter part of 1947 the process was being used in 8 plants in the U. S. and Canada with some 36,000 b/d treating capacity. Several large new plants are in the design and construction stage.

A wide variety of hydrocarbon fractions are being treated, including butane-butene, low-end-point naphtha and full range 400 extreme pressure gasoline; cracked and straight-run stocks; and naphthas derived from naphthenic and paraffinic crude.

The advantages of regeneration of treating solutions by air blowing in the presence of catalysts are: The cost of regeneration through use of air is very low; existing doctor or mercaptan removal treating plants may be easily converted to the new type of operation; low temperature regeneration allows the use of ordinary steel for the required equipment and keeps corrosion at a minimum; the odor nuisance during regeneration is eliminated, since disulfides are formed as a by-product.

The tannic acid sweetening process, which was developed by Socony-Vacuum Oil Co., Inc., has been combined with the Shell Development Co.'s solutizer process for treating gasoline, and the combination known as the tannin solutizer process is licensed by Shell under the patents of Shell and Socony-Vacuum.

Fig. 1 shows a typical flow diagram for the tannin catalyzed regeneration operation, which is briefly described as follows:

The extraction of mercaptans from the gasoline or naphtha is carried out in the usual manner, using countercurrent stages or a packed tower. The treating solution contains the regeneration catalyst and mercaptan solubility promoters are used when required. The fat solution is heated to 115-125° F. to reduce its viscosity and is passed through a coalescer to remove any entrained gasoline, if necessary.

The fat solution is then fed to a packed tower or to other convenient apparatus for securing intimate contact with air, where it is regenerated by air oxidation of mercaptides to disulfides. The solution is carried to a settling vessel where the disulfides are separated. The regenerated solution is returned to the extraction system.

Disulfides are soluble to a small extent in the treating solution. As a consequence, when the air regeneration method is used, a small amount of disulfides will be returned to the gasoline being treated. This solubility varies from several tenths to one per cent by volume of the treating solution circulated, being higher in solutions containing the highest concentration of solubility promoters. Gasoline is also soluble in the treating solution to about the same extent, so that the RSSR re-entry is less than the disulfide solubility.

In order to reduce the amount of disulfides returned to gasoline, auxiliary wash systems have been installed in some plants. Naphtha is generally used as the washing medium and may be periodically rejected or

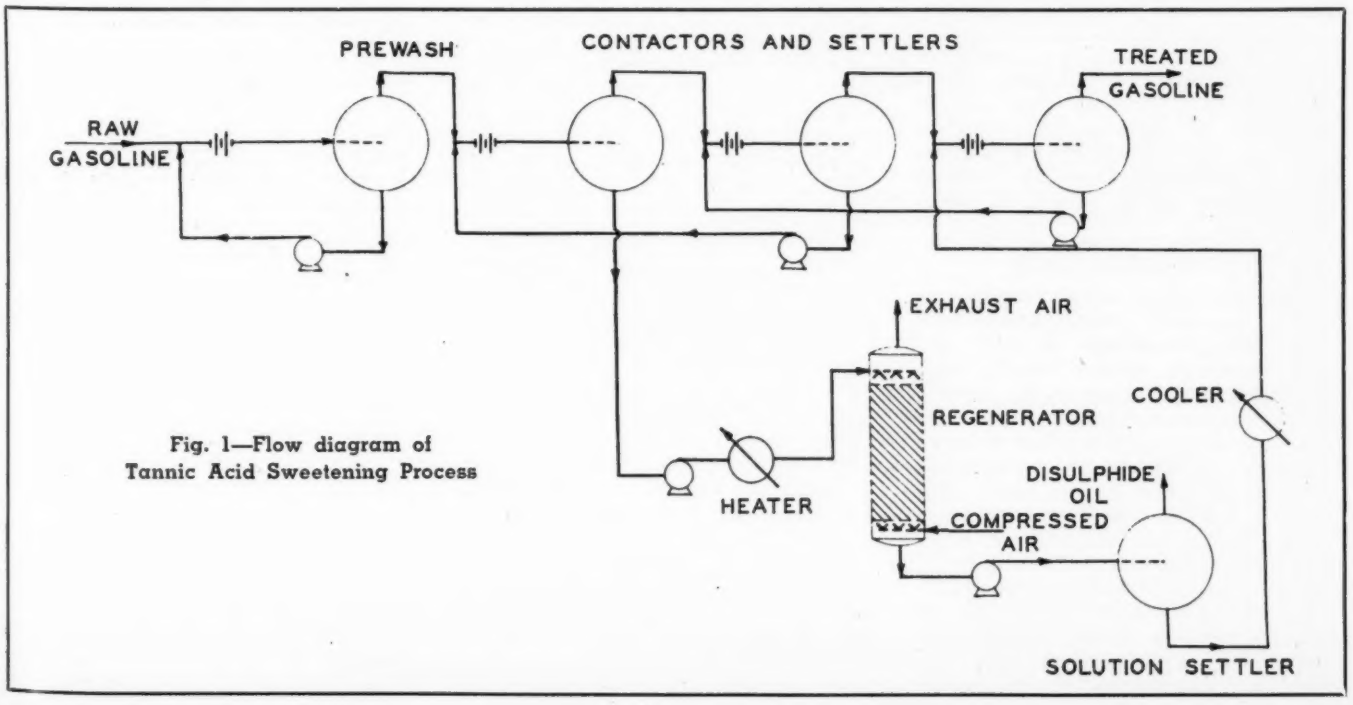


Fig. 1—Flow diagram of Tannic Acid Sweetening Process

TABLE 1—Effect of Catalyst Concentration on Regeneration Rates

(Solution, 10% NaOH; mercaptan, *n*-butyl; temperature, 80° F)

Catalyst Concn.,* Wt. %	Regeneration Rate, % S (RSH)/Min.					
	C.P. tannic acid	Chestnut extract	Wattle extract	Gallic acid	Pyrogallol	Hydroquinone
0.00	0.001	0.001	0.001	0.001	0.001	0.001
0.25	0.07	0.09	0.09	0.08	0.32	0.11
0.50	0.09	0.16	0.18	0.14	0.39	0.19
1.00	0.16	0.21	0.25	0.19	0.55	0.25
3.00	0.18	0.35	0.31	0.25	...	...

* Catalyst concentrations of extracts are based on tannin content as furnished by manufacturers.

TABLE 2—Regeneration Rates of Mercaptans in 10% Caustic Soda Solution Containing 1% Tannin

(Viscosity at 100° F., 1.36 centistokes; temperature, 80° F.)

Mercaptan	Regeneration Rates, % S (RSH)/Min.	
	Wattle	Chestnut
Methyl ..	0.20	0.18
Ethyl ...	0.13	0.13
Propyl ..	0.15	0.16
Butyl ...	0.25	0.21

TABLE 3—Regeneration Rates of Mercaptans in 5 *N*-1 *N* Sodium Cresylate (*p*-Cresol) Solution Containing 1% Tannin

(Temperature, 80° F.; viscosity at 100° F., 4.6 centistokes)

Mercaptan	Regeneration Rates, % S (RSH)/Min.	
	Wattle	Chestnut
Methyl ..	0.12	0.10
Ethyl ...	0.11	0.08
Propyl ..	0.10	0.08
Butyl ...	0.11	0.14
Amyl	...	0.16
Hexyl ...	...	0.16
Heptyl ..	...	0.16

TABLE 4—Regeneration Rates of Mercaptans in Shell Solutizer Solution (6 *N* Potassium Hydroxide—3 *N* Potassium Isobutyrate) Containing 1% Tannin

(Viscosity at 100° F., 4.0 centistokes; temperature, 80° F.)

Mercaptan	Regeneration Rates, % S (RSH)/Min.	
	Wattle	Chestnut
Methyl ..	0.03	0.05
Ethyl ...	0.04	0.05
Propyl ..	0.03	0.04
Butyl ...	0.05	0.05
Amyl	0.03	0.05
Hexyl ...	0.03	0.05
Heptyl ..	0.04	0.05

rerun to remove disulfides. Such naphtha wash streams may also be reformed by thermal or catalytic cracking, which results in the conversion of major portion of the disulfide to hydrogen sulfide which is easily removed.

Development Work

The advantages of mercaptan removal in gasoline sweetening have long been recognized, in that improvements in octane number and in lead susceptibility result through the reduction in the sulfur content. Considerable progress had been made in the extraction of mercaptans through the use of solubility promoters, but the technique of regenerating the treating solutions had presented difficulties. In many cases the agents which have increased the mercaptan extraction power of caustic solutions have adversely affected the ease of regeneration by stripping. Regeneration by steam stripping in addition to a high utility requirement, normally required costly corrosion-resistant equipment.

In the development work by Socony-Vacuum it was found that a number of compounds are capable of promoting a rapid and economical regeneration of treating solutions containing mercaptans by air blowing at slightly above atmospheric temperatures. The disulfides, formed by the oxidation of the mercaptans, are only slightly soluble in the treating solution and may be separated by settling, or complete disulfide removal may be effected.

Those catalysts found most effective for the regeneration of solutions containing mercaptans, in the Socony-Vacuum development work, were tannic acid or tannins, phenolic acids and polyhydroxybenzenes. Desired concentrations of all of these catalysts are soluble in alkaline solutions and, when in solution, are insoluble in the gasoline being treated.

The above catalysts are themselves readily oxidized in alkaline solutions but this oxidation is effectively inhibited by the presence of mercaptans. A certain minimum amount of mercaptan is kept in the treating solution during regeneration to prevent oxidation of the catalyst.

Tannic acid or tannins may be derived from a wide variety of sources such as nut galls, bark, wood, leaves, roots and so on. While all the commercial grades of tannin tested were found to have a benefical effect upon regeneration, the most active of those tested were derived from wattle bark, chestnut bark, tara pods and Sicilian sumac bark.

TABLE 5—Influence of Temperature on Regeneration Rates of *n*-Butyl Mercaptan in 10% Caustic Soda Solutions Containing 1% Tannin

Temp., °F.	Regeneration Rates, % S (RSH)/Min.	
	Wattle	Chestnut
37 ...	0.09	0.07
80 ...	0.25	0.21
114 ...	0.37	...
127 ...	...	0.32

TABLE 6—Comparison of Catalytic Activity of Various Tannins

(Solution, 10% NaOH; mercaptan *n*-butyl; temperature, 80° F.; tannin concentration, 1.0 weight %)

Tannin	Regeneration Rates, % S (RSH)/Min.
Wattle, extract	0.25
Chestnut, extract	0.21
Logwood, crystals	0.21
Sumac (Sicilian), liquid	0.21
Tara, liquid	0.21
Mangrove, liquid	0.16
Oak, liquid	0.14
Cutch	0.11
Quebracho (cold water-soluble), solid	0.11
Ulmo	0.11
Quercitron, crystals	0.09
Quebracho (hot water-soluble), solid	0.07
Gambier	0.05
Osage orange, crystals	0.03

The variable factors upon which the rate of oxidation of mercaptans in alkaline treating solutions depends were recognized as: type of mercaptan, concentration of catalyst used, concentration of oxygen (with air at atmospheric pressure this is constant at the inlet), temperature of contacting, kind of solutizer solution and method of contacting. A standard testing procedure was worked out in the Socony-Vacuum laboratories to study the effect of these variables. It was recognized that the test method adopted for contacting solutizer solutions with air would give only comparative results, since quite different contacting methods would be used in plant operations. However, it is believed that the method gives reproducible results and is thus useful in studying the other variables involved. Results are expressed as regeneration rates in per cent of mercaptan concentration per minute. Tables 1 to 6 show the effect of different variables and catalysts on regeneration rates.

The data given in the tables on regeneration rates, although not absolute, shows the relative efficiencies of the various types of oxidation catalysts studied. The regeneration rate effected after all contacting of air and solution had ceased is not shown, but experimental work showed that the mercaptan sulfur concentration of a solution becomes constant 15 to 30 min. after regeneration at atmospheric temperatures.

A marked concentration effect is possible by the use of small amounts of various catalysts, as shown in Table 1. Rates using 1% of chestnut and wattle tannins are 200-250 times greater than those obtained with straight caustic solutions, and even higher rates were secured with pyrogallol, although the use of the latter has certain disadvantages.

Data in Tables 2, 3 and 4 indicate that the heavier mercaptans are more readily oxidized than those of low molecular weight. Solutions containing solutizers, Tables 3 and 4, have lower regeneration rates than for caustic alone. These solutions also have higher viscosities but it is likely that the type and concentration of solutizer used would have an important effect on the reaction.

Increases in temperature markedly increase the rate of regeneration, as shown in Table 5. However, temperature increases also accelerate corrosion and one of the important ad-

vantages of catalytic regeneration is the ability to avoid operation at high temperatures or pressures. Data in Table 6 indicates the relative activity of various types of tannins. Chestnut and wattle tannins, both of which are readily available commercially, have high catalytic activity.

For the protection of the catalyst, to prevent its oxidation during regeneration, it is necessary that a certain minimum amount of mercaptan be kept in the solution. Experiments were made in the Socony-Vacuum laboratory to determine the approximate concentration of mercaptan sulfur required to protect various catalysts under test. The approximate minimum mercaptan sulfur concentrations required are given in Table 7.

Selection of the most suitable oxidation catalyst for a commercial operation involves consideration of a number of factors, including cost, effect of the catalyst on characteristics of mercaptan solubility promoters, catalytic activity and oxidation stability of the catalyst. Taking a regeneration rate of 0.16% sulfur (RSH) per minute for n-butyl mercaptan in a 10% sodium hydroxide solution as a basis of comparison, and assuming that sufficient mercaptan is present to protect all of the catalysts, the initial catalyst costs for preparation of treating solutions would be as given in Table 8, based on data in Table 7.

The effect of a catalyst upon the

TABLE 7—Minimum Mercaptan Sulfur Concentrations Required for Protection of Regeneration Catalysts

(Mercaptan, n-butyl; temperature, 80° F.)

Catalyst	Catalyst Concn., Wt.%	Mercpatan Sulfur Concn., %
Pyrogallol	0.25	0.35
	0.50	0.45
	1.0	0.60
	1.5	0.75
Hydroquinone	0.5	0.55
	1.0	0.55
	1.5	0.65
Gallic acid	0.5	0.20
	1.0	0.25
	1.5	0.30
Tannic acid, C.P. .	0.5	0.20
	1.0	0.20
	1.5	0.20
Wattle, extract ...	1.0	0.08
Chestnut, extract .	1.0	0.08

TABLE 8—Comparative Cost of Catalysts for Equivalent Regeneration Rates

(Solution, 10% NaOH; mercaptan, n-butyl; basis, 0.16% S (RSH)/minute regeneration rate; temperature, 80° F.)

Catalyst	Required Catalyst Concn., Wt.%	Catalyst Cost, Dollars/100 Gal. of Soln.
Tannic acid, C.P. .	1.00	6.26
Chestnut tannin extract	0.50	0.50
Wattle bark tannin extract	0.45	1.40
Gallic acid	0.70	5.56
Pyrogallol	0.13	1.54
Hydroquinone	0.38	2.88

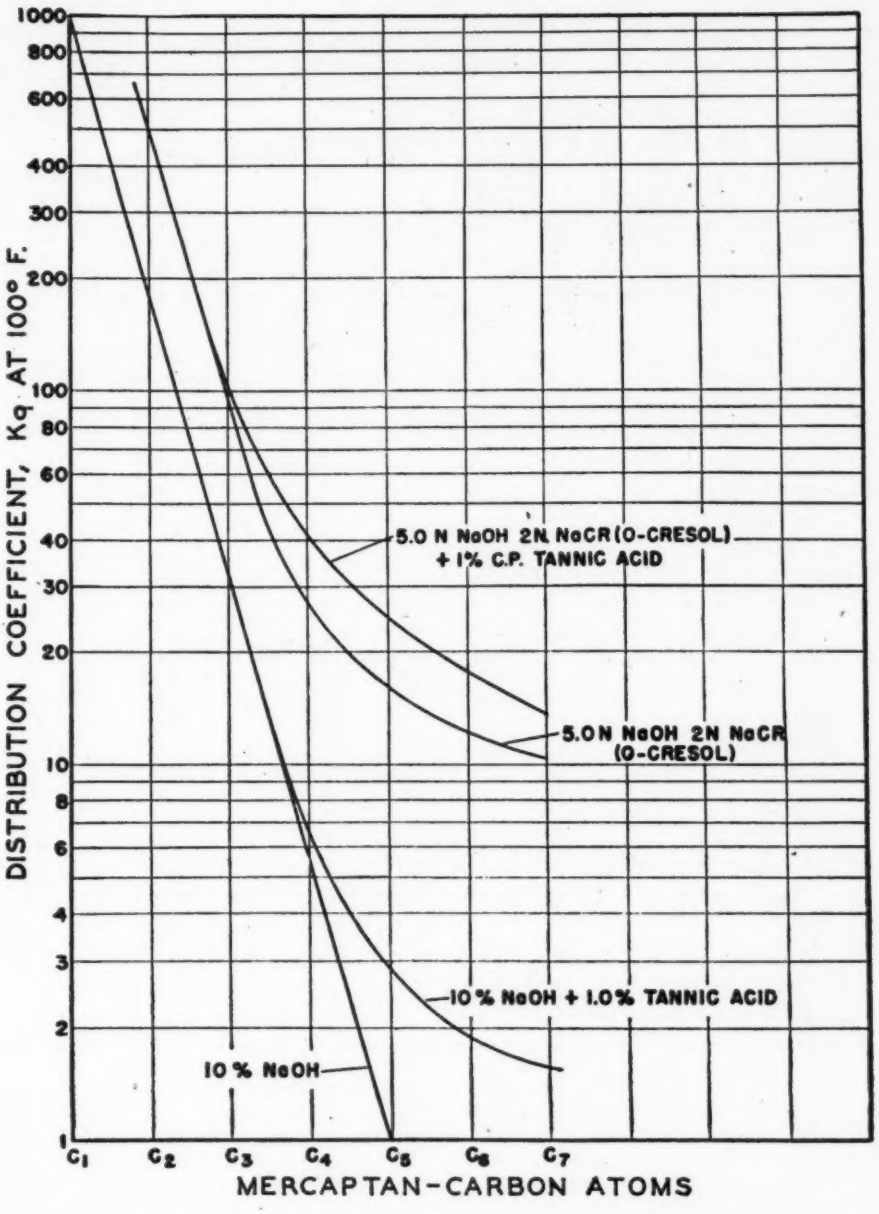


Fig. 2—Effect of tannic acid on distribution coefficients of gasoline treating solutions (mol. wt. of hydrocarbon phase—145)

characteristics of a mercaptan solubility promoter, if present, in the treating solution is important. Tests made on the oxidation stability of mercaptan solubility promoters, in the presence of the oxidation catalysts studied, indicated that, with the possible exception of hydroquinone and pyrogallol, no substantial interaction occurred.

The oxidation stability of a catalyst determines the minimum mercaptan concentration which can be carried in the treating solution and limits the treating application in which a given catalyst may be used. When it is desired to produce a treated gasoline of low mercaptan content (less than 0.001% by weight RSH), the maintenance of a low mercaptan concentration in the treating solution is important. In such cases it may be desirable to use a catalyst which will be protected by less than 0.2% by weight mercaptan sulphur.

Assuming, as was done in preparing Table 8, that a regeneration rate of 0.16% RSH per minute is desired for n-butyl mercaptan, it is apparent from the data in Table 7 that only tannins or gallic acid would be usable, without excessive catalyst loss due to oxidation. Lower mercaptan concentrations can be maintained in the treating solution provided that lower catalyst concentrations are maintained. In order to accomplish this, more effective means of contacting the solution with air are necessary. In any case the relative advantages of the various catalysts remain the same.

In addition to their use as cata-

TABLE 9—Plant Scale Data on Treatment of Motor Gasoline by Tannic Acid Sweetening Process.

(From T.A.C. Report GPG-1)
Extraction Stages—3 Counter-current
Regenerator Vessel-Bubble Tower

Flow Rates

Gasoline, gal./hr.	5350
Prewash Solution, gal./hr.	400
Treating Solution, gal./hr.	870
Air to Regenerator Tower, std. cu. ft./hr.	439

Temperatures, ° F.

Gasoline to Treater	26
Fat Solution to Preheater	33
Fat Solution from Preheater	50
Fat Solution from Heater	104
Regenerator Tower Bottom	105
Lean Solution from Preheater	57

Pressures, psig

Steam to Heater	7
Regenerator Tower	Atmos.
Air Supply	9.5

Analysis of Treating Solution

	Lean	Fat
Gravity, Bé	28.5	....
Sulfide Sulfur, %	0.124	0.222
Mercaptan Sulfur, %	0.720	0.883
Tannin Content, %	3.5	....
Cresylate Normality	0.86	....
Free NaOH Normality	5.66	....
Carbonates, %	0.26	....
Kin. Vis. @ 100° F., cs	5.3	....

Miscellaneous Tests

Analysis of Air from Regenerator

Oxygen, vol. %	13.0
Mercaptan Sulfur, lb./M cu. ft.	None

Analysis of Gasolines

	Raw	Prewashed	Treated
Inspections			
Gravity, ° API	59.9	60.0	60.5
Distillation:			
I.B.P. ° F.	86	82	84
10%	124	128	120
20%	162	165	158
30%	204	205	198
40%	242	241	235
50%	273	271	266
60%	299	296	291
70%	324	320	315
80%	348	345	339
90%	373	372	364
F.B.P.	405	399	396
Recovery, %	96.0	95.0	96.0
Residue, %	1.0	1.5	1.0
Reid Vapor Pressure, psi	12.3	12.3	12.4
Octane Numbers—Motor Method			
Base	67.9	68.3	68.7
Base + 1.0cc TEL/Gal.	72.4	72.4	73.0
Base + 3.0cc TEL/Gal.	76.4	76.9	77.7
Corrosion	OK	OK	OK
Mercaptan Sulfur, %	0.081	0.053	0.004
Total Sulfur	0.27	0.23	0.19
Copper Dish Gums, mgm/100 ccs			
After addition of 1 gm. x-naphthol/bbl.	30	....	5
After addition of 2 gm. x-naphthol/bbl.	28	....	7

lysts in the oxidation of mercaptans to disulfides, the tannins also exhibit some mercaptan solubility promoting effects. These effects are limited to n-butyl and heavier mercaptans, as shown in Fig. 2. Although this feature is secondary, it is of interest in the treatment of gasolines containing small amounts of heavy mercaptans which do not require the use of special solutizing treating solutions.

When the proper mercaptan concentration is maintained, the consumption of catalyst is only by mechanical loss or spillage and this ordinarily is very small. The catalytic activity of a catalyst will influence the design of a regeneration system or, conversely, the existing regeneration facilities will influence the choice of the catalyst to be used.

Based on results of the Socony-Vacuum experiments, it was felt that the tannins showed the greatest promise of successful application. They have been employed in commercial scale operations and the results of their use have provided confirmation of the experimental data described above. The tannic acid catalyst cost during the war period was reported as on the order of $0.0001 per barrel of gasoline treated. Tables 9 and 10 give representative full scale data taken from plant operations on the treatment of a full range gasoline and on an alkylation unit feed stock.

Application of the process for the treatment of C_4 fractions is described as attractive, since methyl mercaptan is difficult to remove from treating solutions by steam stripping and the tannin caustic system may be operated without the use of exchangers or coolers.

In treating gasolines, cresylates or other solutizers are employed, and often potassium hydroxide is used in preference to sodium hydroxide. Typical solutions will employ 5 *N* hydroxide and 2 *N* sodium alkylphenol or 6 *N* potassium hydroxide and 2.5 *N* potassium alkylphenol. For the same viscosity, not exceeding 10 centistokes, higher concentrations are possible when using potassium hydroxide.

Gasolines containing up to 0.2 wgt. % mercaptan sulfur are treated to obtain a reduction of mercaptan content of about 90%. Gasolines containing approximately 0.006% mercaptan sulfur can be readily scrubbed down to less than 0.001% and will then sweeten completely in storage. However, little lead saving is accomplished by scrubbing much below 0.002-0.003% mercaptan sulfur. Gasolines of this mercaptan content are generally satisfactory to the consumer, and tests indicate that their performance is in no way impaired.

Extraction equipment used has varied to a considerable extent, as several of the units in operation were converted from existing doctor sweetening units during the war, when it was difficult to obtain new equipment. Stage mixers and settlers are at present the most common type of contactors, and a typical installation will employ one such stage for precaustic washing followed by three countercurrent extraction stages. Packed towers and perforated tray towers have also been employed.

For contacting regeneration air with the treating solution, turbomixers and drilled pipe distributors have been employed with success. The air requirement is usually no more than 2-3 times the theoretical for oxidation of the mercaptan. The use of porous ceramic or graphite diffusers, such as are used in water aeration, has also been recently tried with success.

By the use of the naphtha wash mentioned previously it is possible to prevent disulfide return almost completely, so that the mercaptan removed in the extraction stage is credited to lead savings.

TABLE 10—Plant Scale Data on Treatment of Alkylation Unit

Feed Stock by Tannic Acid Sweetening Process
(From T.A.C. Report GPG-1)
Extraction Stages—3 Counter-current
Regenerator—Bubble Tower

Flow Rates

Butanes, gal./hr.	1950
Treating Solution, gal./hr.	200
Air to Regenerator Tower, Std.cu.ft./hr.	36

Temperatures, ° F.

Butanes to Treater	70
Fat Solution to Heater	72
Fat Solution to Regenerator	115
Lean Solution from Settler	100

Pressures, psi gage

Regenerator Tower	Atmospheric
Air Supply	8

Analyses of Treating Solution

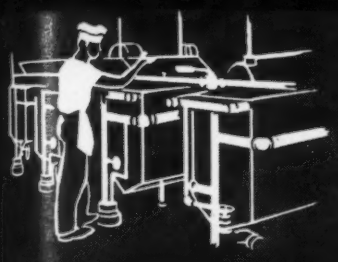
	Fat	Lean
Gravity, Bé	...	12.2
Sulfide Sulfur, %	...	0.0
Mercaptan Sulfur, %	0.38	0.30
Tannin Content, %	...	0.25
Total Alkalinity, %	...	9.5

Analysis of Butanes

	Prewashed Feed	Treated Feed
Mercaptan Sulfur, %	0.029	0.0008
Total Sulfur, %	0.039	0.012

Acknowledgment

The accompanying article has been prepared from data contained in Report GPG-1 of the Technical Advisory Committee of the Petroleum Industry War Council, "The Tannic Acid Sweetening Process", by S. P. Cauley and John Happel, Socony-Vacuum Oil Co. Inc. Technical Service Division, Brooklyn; also from "Tannins and Allied Chemicals in Mercaptan Removal Process", by J. Happel and S. P. Cauley, presented before the Division of Petroleum Chemistry at the 110th Meeting of the American Chemical Society, Chicago, and published in *Industrial and Engineering Chemistry*, December, 1947.



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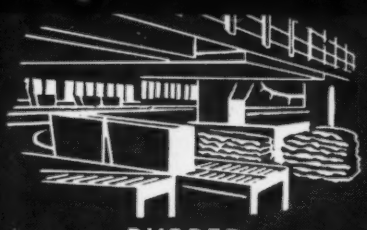

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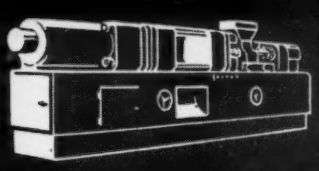

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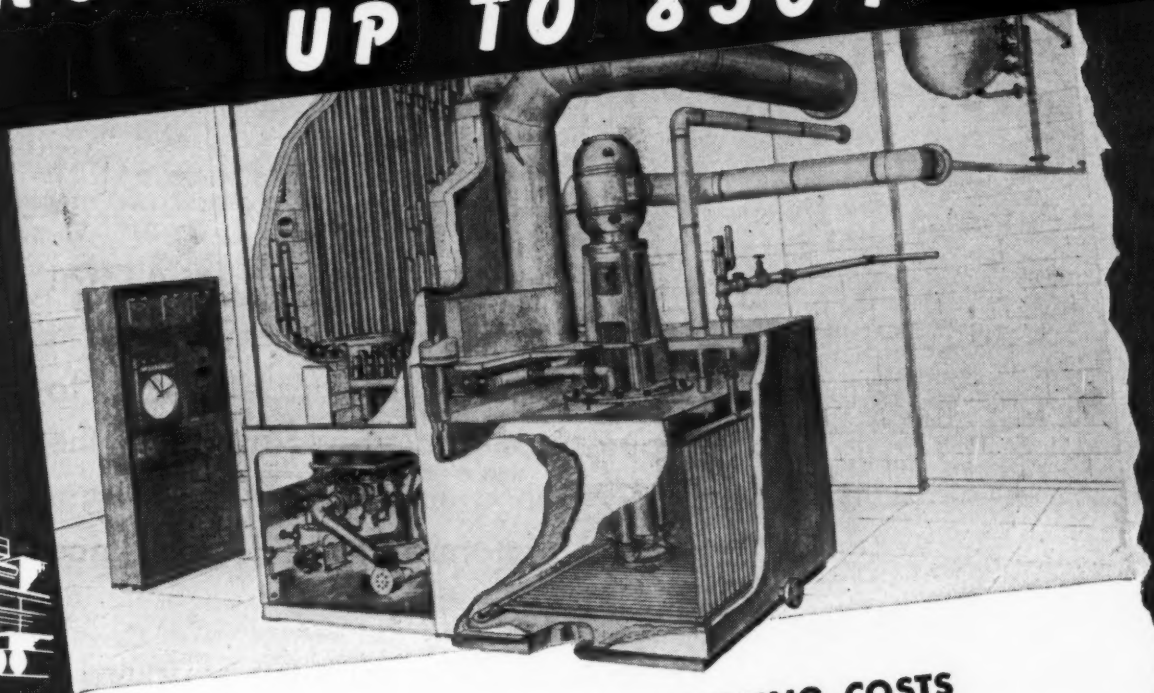

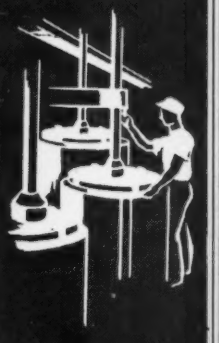

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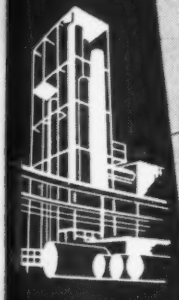

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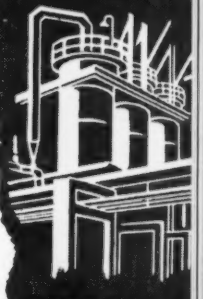

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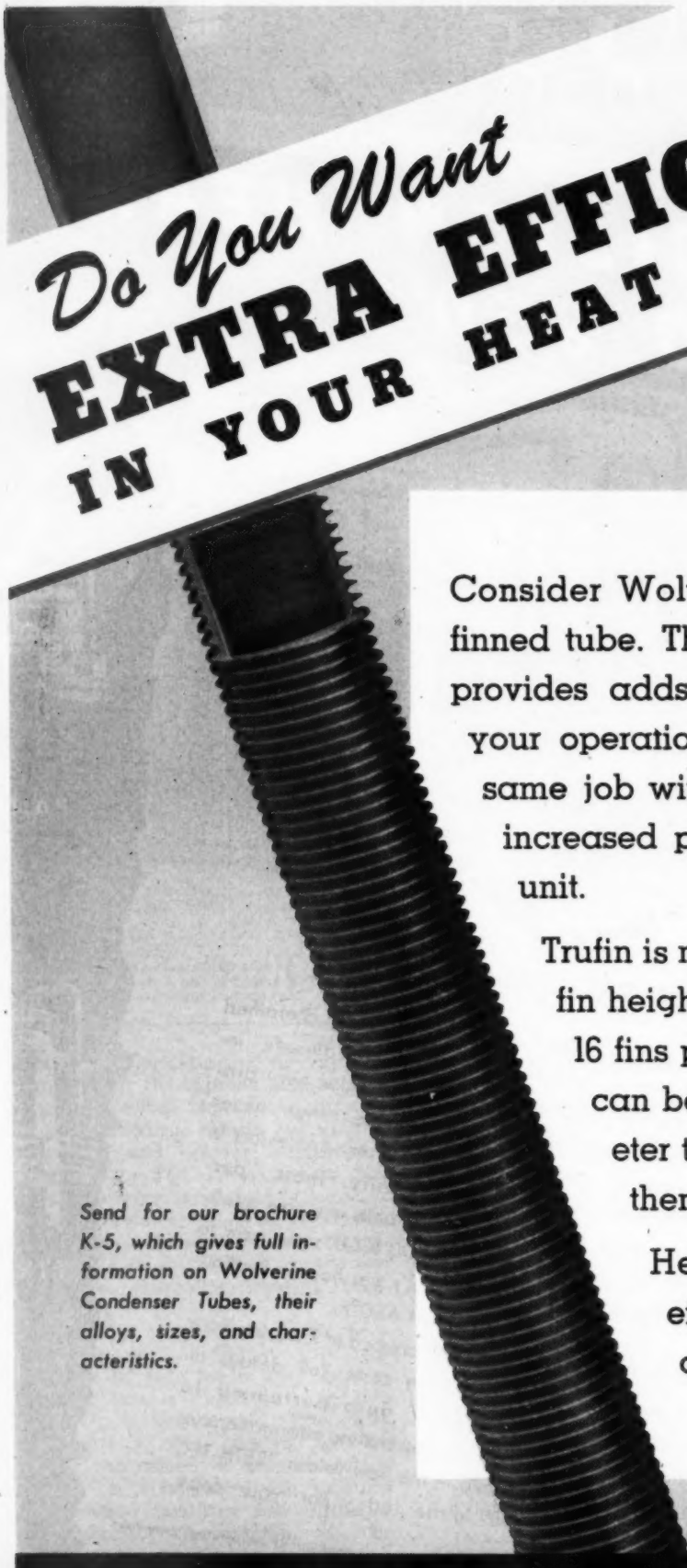

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INSTRUMENTATION of an ALKYLATION UNIT

By HARRY F. MOORE and GEORGE W. GROSS
Esso Engineering Department
Standard Oil Development Co.

The basic design for the main control and measurement instrumentation for an early commercial alkylation unit provided more than the normal allowances for some operating variables because these factors had not yet been fully defined. Modifications in the original design which were required in a few instances are analyzed. In control instrumentations of this type the authors believe consideration is warranted for building storage spaces such as reflux drums, tower bottoms and vapor spaces larger in relation to flow rates as a means for insuring a greater degree of stability in temperatures, pressures and flow rates.

THE petroleum refinery unit whose control and measurement instrumentation is discussed in this paper is a commercially demonstrated one on a relatively large scale. It was designed and constructed by the Standard Oil Development Co. for the Aruba refinery in South America prior to the recent war, and became known to the petroleum industry as an alkylation plant. Its chief function was to promote an addition or "alkylation" reaction between an isoparaffin (such as isobutane) and an olefin (such as butenes) to produce isooctane for aviation gasoline.

The design principles leading to the selection of the main control and measurement instrumentation of the unit are discussed. In addition, the operating performance of the instrument installations together with any needed modifications to the original design by the Aruba refinery instrument people are analyzed. The authors point out that it is due to the complete records which the local refinery instrument department obtained that such an analysis was possible.

At the time this unit was designed, the alkylation process was a relatively new development in the petroleum field and, in fact, was just emerging from the laboratory stage. It was recognized when the method and type of instrumentation was being specified that there were a large number of exploratory variables which affected the alkylation reaction, and the most successful operation of the unit would eventually depend upon the optimum balance of these variables. Because of this situation, more than the normal allowances in design methods were employed in some items

In a few instances, certain control methods and types of instruments required some modification after the unit was placed in operation. The authors have attempted to discuss such situations in order that the early experience gained may be of the most value to the readers. Operating experience on other company units has also been used to supplement the Aruba information, which was collected in June, 1941, approximately a year and a half after starting operations. Before discussing the instrumentation, a brief description is presented of the alkylation process as practiced at the time the unit was designed.

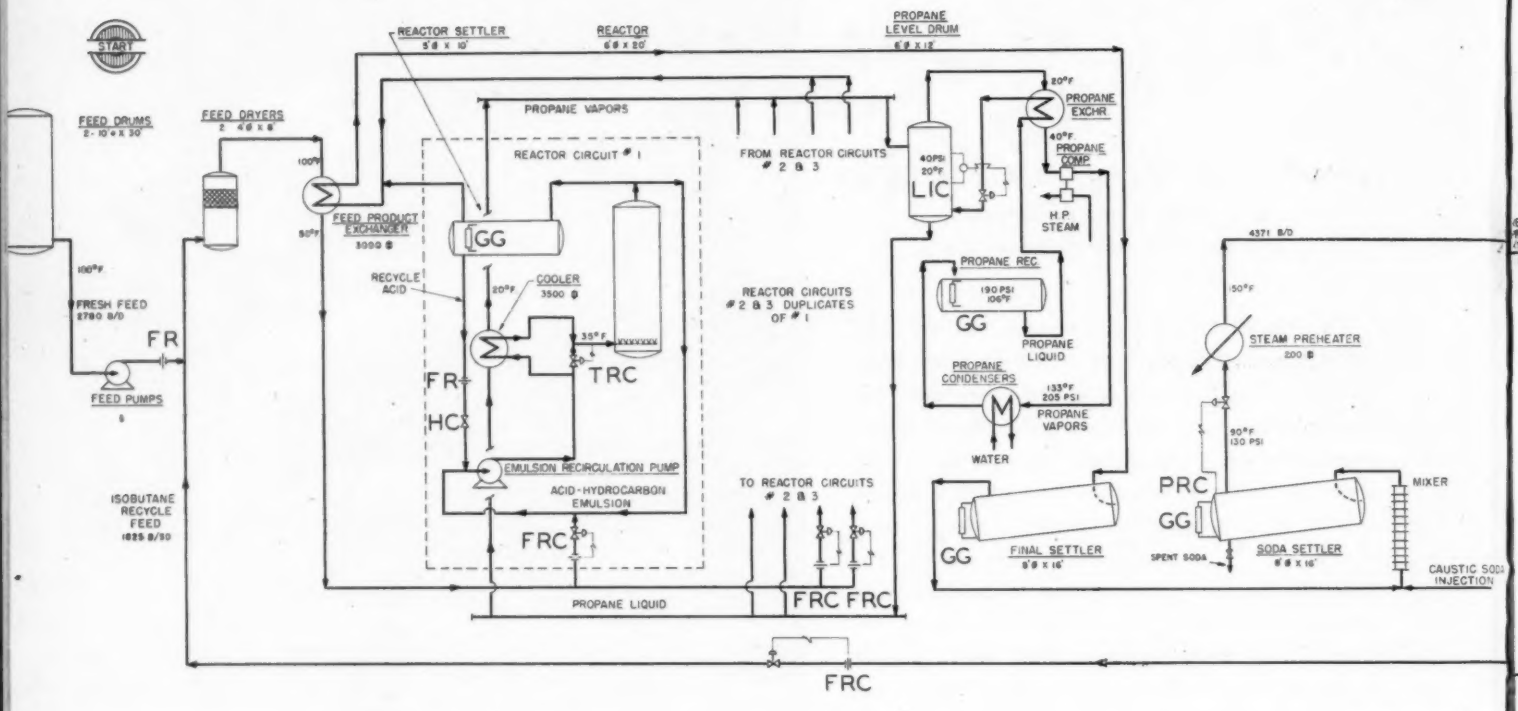
Description of Process

The commercial alkylation process may be conveniently subdivided into three main sections namely, reactor, refrigeration, and fractionation. In the reactor section the alkylation reaction takes place. This reaction liberates heat and is carried out in the liquid phase at a temperature range of 30-40° F. using concentrated sulfuric acid as a catalyst. The raw material or feed stock to the unit is delivered directly to the reactor section and consists chiefly of the various saturated and unsaturated four-carbon atom hydrocarbons boiling in the range of 10°-35° F. The desired product from the reactor section is the maximum yield of high-octane aviation gasoline blending stock, or "alkylate" produced from the isobutane and butene portions of the feed stock. This alkylate has a boiling range of 125 to 250° F.

In addition to the alkylate product, a small percentage of high molecular structure polymers known as heavy alkylate is produced. The remaining material from the reactor section consists of the unreacted portion of the feed stock referred to as "spent butane", plus an isobutane stream which is recycled to the reactor section. The recycle isobutane is of major importance in securing the high quality and yield of alkylate because it minimizes the reaction of the unsaturated hydrocarbons with themselves with the consequent formation of heavy polymers.

The refrigeration section of the unit serves merely to supply the reactor section with sufficient refrigeration to maintain the optimum alkylation reactor temperature. A conventional refrigeration recycle system is employed using commercial propane as the refrigerant.

The alkylation unit fractionation section serves to segregate by means of fractionating towers and attendant equipment the various products from the reactor section into the desired cuts of recycle isobutane,



EXPLANATION

LI—Level Indicator
LIC—Level indicating controller
FR—Flow recorder
FRC—Flow recorder controller
TRC—Temperature recorder controller

Fig. 1—Basic flow diagram for the alkylation unit at the Aruba refinery, showing schematically the sequence of operations, of processing equipment conditions, and of the chief instrumentation. Also shown are

spent butane, aviation alkylate and heavy alkylate.

The basic flow plan of the alkylation unit illustrating schematically the processing sequence, equipment, operating conditions, and the main measurement and control instrumentation is presented as Fig. 1.

Basic Design

It may be noted from Fig. 1 that the instrumentation was designed to provide continuous overall operation of the unit with the minimum of manual adjustments. At the same time, the major operating variables that affect product yield and quality in each section of the unit were fixed by automatic control instruments. For example, the quantity and ratio of isobutane and olefin feed stock to each reactor circuit was fixed by the flow controller on the isobutane recycle feed stream together with the flow controllers on the total feed to each reactor circuit. The reaction temperature was fixed by a temperature controller on the acid-hydrocarbon emulsion stream of each circuit.

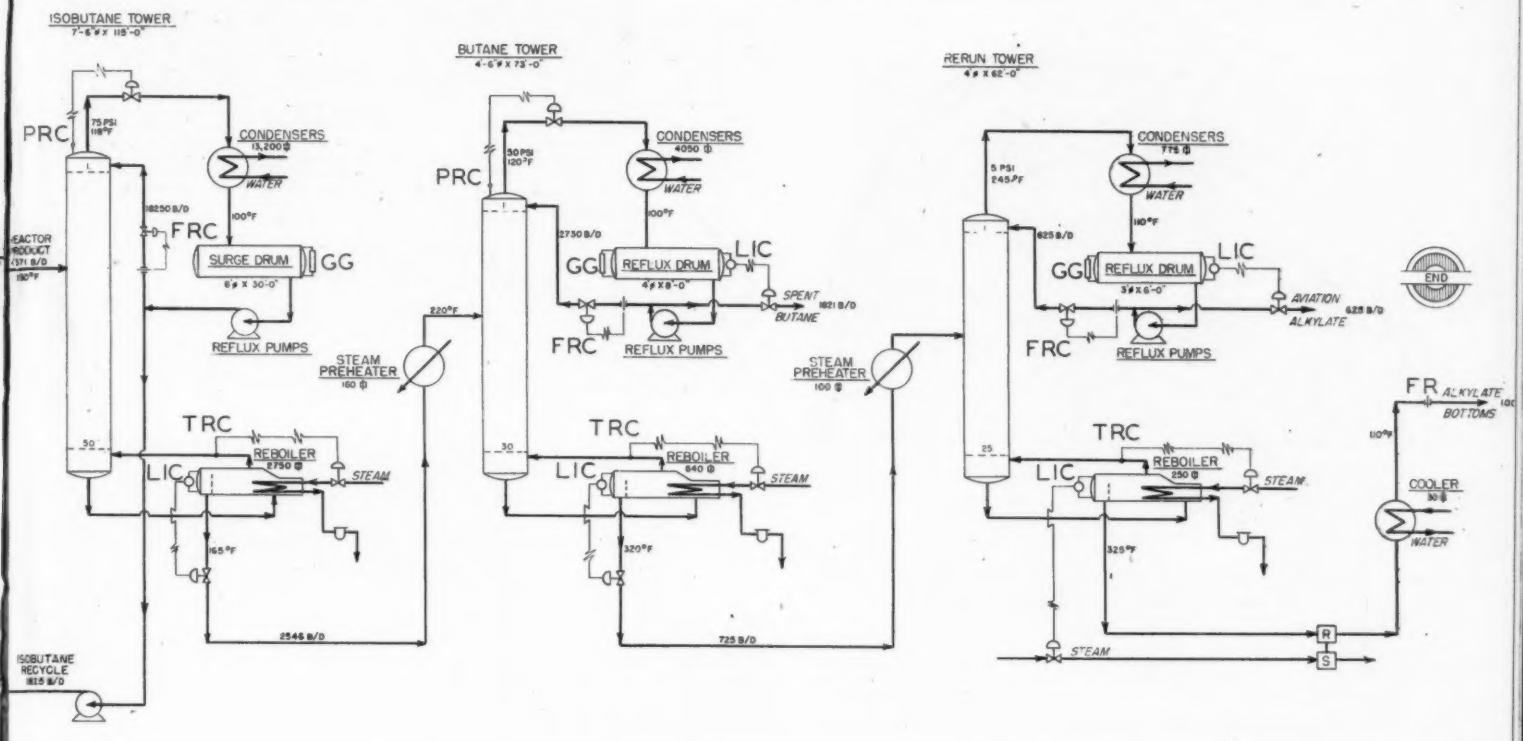
The reactor products flow to the fractionating section where in each successive tower operation the desired products are continuously separated and pumped to storage under automatic control. The major operating variables such as the tower operating pressure, reflux ratio, and bottoms temperature are maintained at their desired values by automatic control instruments.

The instrumentation for each of the fractionating towers is somewhat similar. For this reason a detailed description of the basic design principles of only one of the towers will be given. The isobutane tower has been selected because it represented at the time the unit was designed in 1939 one of the first commercial large-scale precise fractionating towers of the company. The primary function of the isobutane tower was to effect a maximum separation between the isobutane and normal butane portions of the material from the reactor section. The difference between the atmospheric boiling points for these two hydrocarbons is about 20° F. The isobutane tower was designed for a 98% recovery of the isobutane in the tower feed to overhead product for recycling to the reactor section.

Since increasing pressures effectively reduce the difference in boiling points between iso and normal butane, it was considered economical to select the minimum tower operating pressure that would permit condensation of the isobutane overhead product with refinery cooling water in the overhead condensers. For the selected condensation temperature of 100° F., the tower operating pressure was set at 75 psi. Because the isobutane overhead product has a very narrow boiling range, essentially complete condensation is effected and gas is not normally produced from the overhead accumulator.

The conventional fixed gas release valve could not be used, and a control valve in the tower vapor line was employed. In order to keep the heat transfer surface of the condensers to a minimum, the lowest pressure drop (consistent with good control) was necessary. This control valve was actuated by the tower pressure controller whose pressure element was located in the upper vapor space of the tower. The tower reflux ratio was fixed by a flow controller in the reflux return line. This was considered essential in the securing of constant reflux since such factors as daily cooling water temperature variations, and condenser fouling would vary the accumulator pressure which, in turn, would result in variations to the pumping characteristics of the reflux pumps.

Control of the tower vapor line temperature, with the control valve in the reflux line, was not used because of the very narrow boiling range of the overhead vapors. It was considered necessary to be able to set the quantity of recycle isobutane to the reactors at a desired rate dependent upon reactor conditions. Therefore, the accumulator was de-



OF SYMBOLS

PRC—Pressure recorder controller
GG—Gage glass
HC—Hand controller
Ø—Diameter
□—Sq. Ft. exchange surface

the design flow rates between various sections, and the number and size of reaction vessels and surge drums needed in connection with the control of the process. Incoming flow begins at feed drums at left

signed with sufficient storage to absorb the effect of the time lag in recycling isobutane from the accumulator to the reactors and back through the tower.

The composition of the tower bottoms relative to isobutane was fixed by means of a temperature controller which actuated a control valve in the reboiler steam line, thereby controlling the heat input to the reboiler. The temperature element was located in the vapor line from the reboiler. The feed preheater which was the other source of tower heat input was under manual control, since it represented less than 10% of the total heat input to the tower. The tower bottoms product was continuously removed from the reboiler accumulator section by means of a level controller. It was considered imperative that the flow stability of this level controller be as excellent as practical to minimize variation in feed rate to the butane tower.

It may be seen, therefore, that the major operating variables were placed under automatic control. The remaining free major variable was the composition of the tower overhead, which was dictated by the "built-in" features of the tower. These features include the number and the efficiency of the bubble-cap type plates provided in the tower.

FIELD PERFORMANCE PRESSURE MEASUREMENT, CONTROL

Isobutane & Butane Towers: Charts P-1 and P-2, in Fig. 2, illustrate typical tower pressure records with control by means of vapor line valves. Consistently good results were obtained at Aruba, and also at other locations. Table I indicates one early trouble was caused by large unbalance of forces on the butterfly of the valve, and necessitated the installation of valve positioners. No one today would attempt to use a diaphragm-operated butterfly valve without a valve positioner. In 1939, however, two conditions existed which led to omitting them in the original design. These were (1) lack of experience with butterfly valves; so that their high torque requirements came as a surprise, and (2) valve positioners available were either flimsy or unstable, so that their use was held to a minimum.

Experience with the butterfly valves was very interesting. First came the matter of sizing. Information available on their capacities was meagre, and the sizing had to be done in a somewhat arbitrary manner. The sizing proved to be remarkably good. Secondly, torque or force requirements of these valves is high compared to the conventional control valves, as indicated by the need for valve positioners. Even with the positioner in service and process conditions stable it was noted that diaphragm pressure fluctuated rapidly (not in a cyclic manner, but in an aimless way) as much as 15% of the normal operating range of 12 psi. while air pressure from the controller was unchanged.

This is ample evidence of the underpowering of these valve operators. The concluding evidence came on a subsequent unit, when it was found impossible to operate the isobutane tower valve beyond a 25% open position, due to inability of the diaphragm motor to move the butterfly vane against internal forces. Before this condition was remedied the diaphragm effective area was approximately doubled and the operating air pressure range increased from 12 to 20 psi.

Chart P-2 shows a slight "sawtoothing" which was frequently encountered on these butterfly installations, particularly when operating with the butterfly vane in the nearly-closed position. Although these slight pressure fluctuations had no apparent effect on operation, they should be eliminated when it is possible to do so. The importance of this on the isobutane tower is obvious when it is considered that a change in tower top pressure of 1 psi. demands a change in temperature of almost 1° F. This inter-relation of

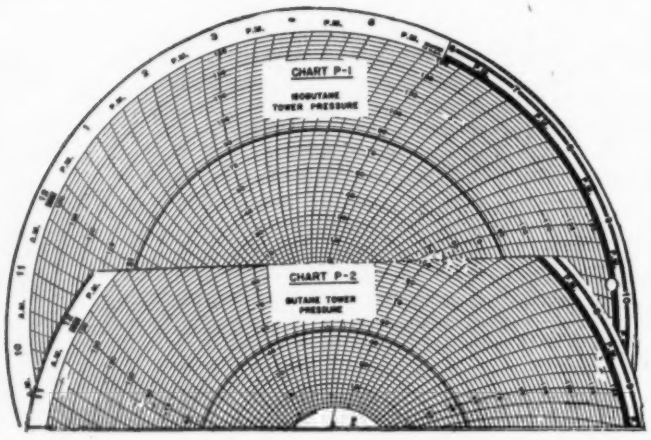


Fig. 2—Charts P-1 and P-2, which illustrate typical isobutane and butane tower pressure records

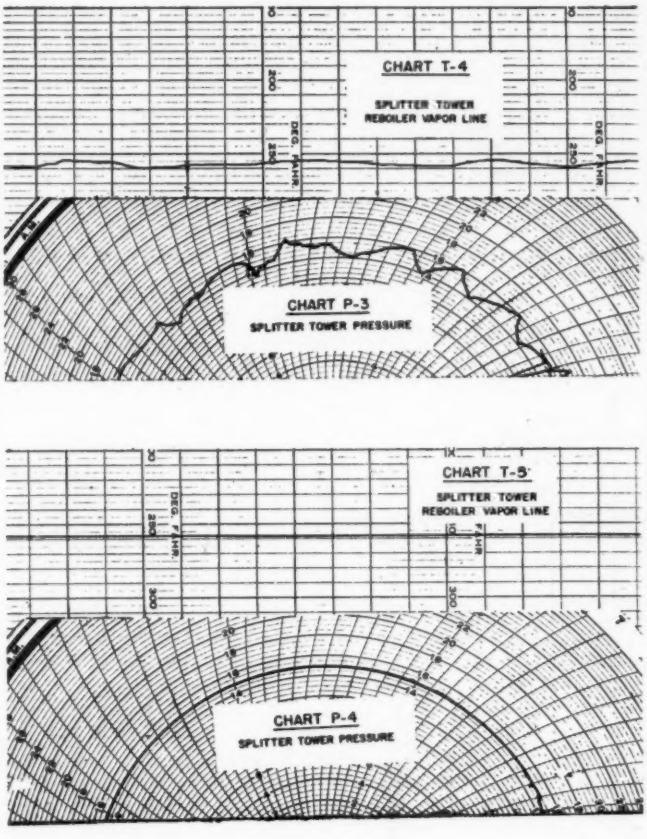


Fig. 3—Charts showing inter-relationship of temperature and pressure in a splitter tower and its reboiler vapor line

temperature and pressure is illustrated by charts T-4 and 5, and P-3 and 4 in Fig. 3 which were obtained from another tower. Charts P-3 and T-4 cover the same time interval as do P-4 and T-5.

The tower pressure was fluctuating due to improper control valve action (control valve located in water supply line to overhead condensers). As a result, the tower temperatures fluctuated, even though the reboiler temperature controller was attempting to compensate. When the pressure control was straightened out (Chart P-4) the temperature control record immediately stabilized (Chart T-5). This, incidentally, is a perfect example of the need for intelligent analysis of so-called "instrument trouble." No amount of work on the temperature controller alone was going to save the situation. The old question of whether the egg or the hen came first is of utmost importance.

From work done on an isoprene fractionation tower, it is felt that improved control of the tower pressures could be obtained by supressing the zero point of the range, thus using an amplified scale. In some respects this would be similar to what has been done in replacing the galvanometers of pyrometers with amplifiers which allow narrow temperature spans. It is known that two instrument manufacturers are doing some work on such amplified pressure instruments. It is not improbable that precision amplified measurement of tower pressures, with consequent improved control, could furnish the answer to the tower bottom temperature control troubles in the Aruba unit.

TEMPERATURE MEASUREMENT CONTROL

Fractionation Section: The temperature control originally provided on the iso-butane tower reboiler was unsatisfactory and Table I indicates that after some improvement, attributed to a change in instrument type, automatic control was abandoned. This history was repeated on several other iso-butane tower installations. Chart T-1 in Fig. 4 shows a typical temperature control record, taken from another isobutane tower prior to abandoning automatic control.

Subsequently various attempts were made to improve isobutane tower control. These included measurement of differential pressure across the tower, automatic bottoms heat control by temperature at the 13th plate, and automatic bottoms heat control by differential temperature across a 10-plate tower section. This last method is reported to be satisfactory.

This temperature control application was confronted with several interesting service conditions. First and foremost, instrument engineers observing tower operation were amazed at the time it took for a change in reboiler steam flow to be reflected in temperature change throughout the tower. Intervals of 5 to 10 minutes were measured, for a large steam flow change to begin changing the 13th plate temperature. On hand control it was felt by many operators that one change per 30 minute period was the maximum that could be made without danger of serious upsets. In the rough and ready language of the refinery it was said "make a change today and see the effect tomorrow".

A second item which contributed its share to the problem was an old "friend" of temperature control, namely condensate removal. With the reboiler temperature around 150° F., and heat transfer surface designed for exhaust steam, a reboiler steam pressure below atmospheric was expected. To discharge the condensate, the Aruba unit was designed with a condensate drum vented back to the reboiler. A level controller operated a pump discharging the vacuum condensate to the regular system.

Other units were designed with the so-called "pumping traps". These traps proved to be consistently troublesome and some of the control difficulties were traced to their operation. Because of these difficulties, together with other data which became available, subsequent designs dispensed with the reboiler trap altogether by installing the control valve in the condensate line and putting full steam header pressure in the reboiler tubes. This type of installa-

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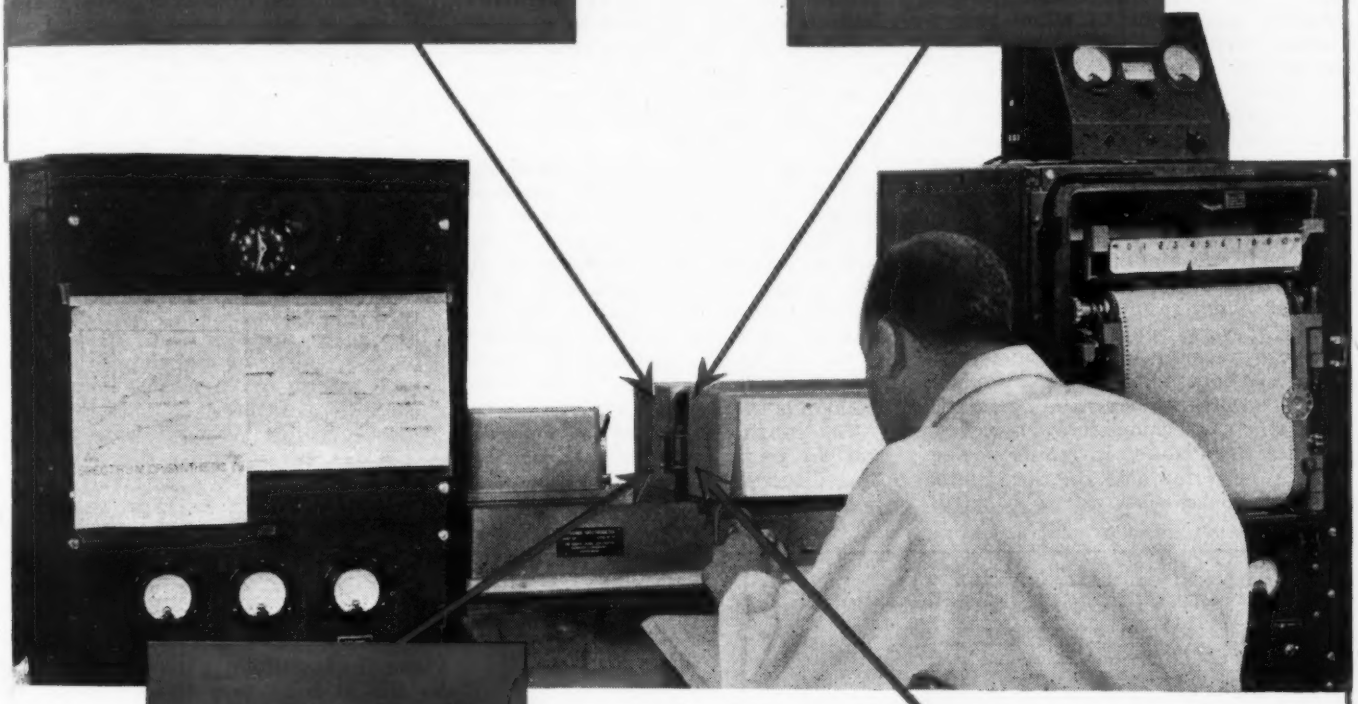

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tion, while it is no panacea, has given consistently good results on temperature control applications.

The isobutane tower application and later, during the war, the butadiene, toluene and isoprene fractionation applications focused attention on the basic need in pure product fractionation work for temperature equipment with small temperature spans, so that 1° F. can be seen on the chart and represent enough physical movement to allow proper control response. On an early job, an attempt was made to use a 100° F. span, iron-constantan pyrometer of the galvanometer type. This proved unsatisfactory, due to the limits of industrial galvanometer characteristics, and the range was changed to 350° F. Recent developments of pyrometers without galvanometers, using electronic amplification, have allowed the use of the narrow ranges, with excellent results.

The question could be raised "why not use resistance thermometers?" This was done on some pure product work, with good *operating* results. Resistance thermometers, however, are heartily disliked in refineries due to (1) need for soldering of joints, with a consequent safety problem whenever a bulb must be replaced, (2) resistance troubles wherever contacts or switches are involved, due to corrosive nature of refinery atmospheres, (3) fragility of most bulb designs compared to couples.

A scrutiny of the Aruba isobutane tower control application brings out the fact that the fundamental requirement is to run for minimum loss of isobutane in the tower bottoms. Thus, control by temperature is essentially indirect control. Control by analysis for isobutane in the bottoms would be highly desirable. The infra-red absorption analyzers offer some hope along this line, and trial installations are now being made.

Reactor Circuit Coolers: Removal of heat in the reaction zone involved control of the large amounts of refrigeration. Early designs such as Aruba, having little background on this point, were provided with individual circuit temperature controllers, to allow for possible variations in the alkylation reaction in the three circuits, uneven results in the heat exchanger type coolers, etc.

The tabulation shows the field result to be "instrument not needed. Temperature held constant by automatic control of refrigerant compressor suction pressure." Chart T-3, in Fig. 4, temperature of feed from a reactor cooler, illustrates the constant temperature obtained. As a result of this experience, the temperature control equipment was removed for use elsewhere in the refinery. Subsequent plant designs omitted the temperature controllers.

LEVEL CONTROL

Continuous processes have many pieces of inter-related equipment as amply illustrated by the flow sheet. As a result of the inter-relationship, one of the primary requirements of satisfactory processing is stability of the temperatures, pressures and flows. These temperatures, pressures and flows could be held stable even with hand adjustment of valves by building such storage spaces as reflux drums, tower bottoms and vapor spaces large relative to the flow rates. By "large" is meant a storage space equal to 15 to 30 minutes of flow. This much storage causes such inertia or "flywheel' effect that the temperatures, pressures and levels change slowly, even though the flow rates set by the hand operated valves are appreciably away from the proper average value.

TABLE 1—Tabulation of Instrumentation Changes—tabulation covers only those applications discussed in this article

Application	Instrument	Changes	Reason
Pressure: Propane Level Control Drum	Indicating controller with adj. prop. band and adj. reset.	None	
Pressure: Isobutane Tower	Recording controller with adj. prop. band and adj. reset.	None to instrument	
	Valve, 10", air operated butterfly.	Installed valve positioner	Perfect control of tower pressure is essential, for which positioner was needed. Control now very satisfactory.
Pressure: Butane Tower	Recording controller with adj. prop. band and adj. reset.	None to instrument	
	Valve, 6" air operated butterfly.	Installed valve positioner	Perfect control of tower pressure is essential, for which positioner was needed. Control now very satisfactory.
Flow: Nos. 1, 2 and 3 Circuit Feed	Mercury manom., pneumatic transmission recording controller with adj. prop. band.	Adj. reset added to controller. Orifice size increased.	Prop. control caused wandering of control point, due to line pressure changes. Rate at full meter differential changed from 3500 to 5100 G/H.
Flow: Recycle Isobutane	Mercury manom., pneumatic transmission recording controller with adj. prop. band. Reflux accumulator record on same chart.	None	
Temperature: Nos. 1, 2 and 3 Circuit Cooler	Potentiometer recorder controller with adj. prop. band and adj. reset.	Instrument removed.	Not required. Temp. is controlled indirectly by pressure control of refrigeration compressor suction.
Temperature: Isobutane Tower Reboiler Vapor	Potentiometer recorder controller with adj. prop. band and adj. reset.	Replaced with indicator controller with more direct mechanical tie-in from galv. to control mechanism.	Control not satisfactory. Better with replacement, but hand control preferred by operators.
Temperature: Butane Tower Reboiler Vapor	Same as above.	None	
Level: Rerun Tower Accumulator	10 inch range ball float indicating level controller with adj. prop. band (to max. of 80%) & adj. reset. Float also operates switches for 3-light signal.	Reset removed.	Due to action of reset, alkylate to storage flow rate was unstable, even with slowest reset. Inst. now satisfactory.
Level: Isobutane Tower Reboiler	Same as above.	Replaced by control mech. allowing adj. prop. band to approx. 1500%. Reset included.	More stable flow was required and obtained.
Level, Spent Butane Accumulator (Butane Tower Reflux Drum)	Same as above. (except reset omitted.)	None	

To build the storage spaces this large would add considerably to the required investment and in some cases would raise questions of practicality. The actual holdup time in most cases was in the order of magnitude of two minutes. The butane tower reflux drum for example, had a holdup time of 1½ minutes based on reflux plus product withdrawal.

The maintenance of stable process conditions with such small storage space between the inter-related pieces of equipment is one of the jobs which justifies the expense of the control equipment installations. In engineering the control installations and in selecting the equipment it is, therefore, essential that consideration be given at all times to the question of stability. Several papers dealing with a mathematical analysis of such problems have recently appeared in the literature. Such methods are not used by industry as (a) the mathematical analysis is at best satisfactory only for a single or two capacity process, (b) the assumptions necessary to such an analysis cannot be set with any reasonable precision, and (c) a mathematical analysis assumes instruments of infinite responsiveness and linear relationships. With reference to the last points of responsiveness and linearity, the instrumentation of this 1939 design and also of present 1947 designs misses both by uncomfortably wide margins.

In place of a mathematical analysis, the guide post used in the design work was based on experience with storage, or "holdup time" as it is sometimes called. For example, on level control the volume of liquid within the range of the level controller, expressed in terms of the number of minutes of flow rate it represents, is the major consideration. The second consideration is the need for stability (excellent, moderate or unimportant) as established from a study of the process together with experience.

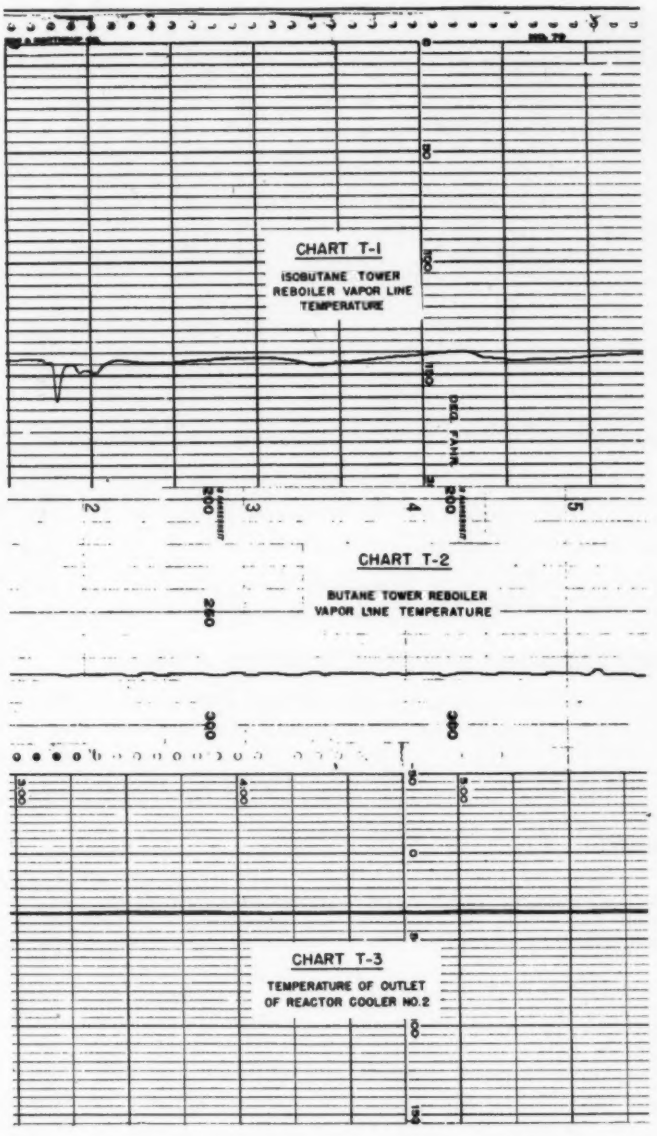
CHART T-1
ISOBUTANE TOWER REBOILER VAPOR LINE TEMPERATURE
CHART T-2
BUTANE TOWER REBOILER VAPOR LINE TEMPERATURE
CHART T-3
TEMPERATURE OF OUTLET OF REACTOR COOLER NO.2

Fig. 4—Typical temperature record charts—T-1, for the isobutane reboiler vapor line; T-2, for the butane reboiler vapor line; and T-3, for the outlet of a reactor cooler

Chart L-1 shows the record of flow through the butane tower reflux drum level control valve. This is not a stable record as the flow rate changes abruptly at unpredictable times. This is true despite the fact that flow of condensed vapor to the drum and reflux from the drum were entirely stable. The jumpy action is the result of the inability of a short range ball float level controller to follow the level closely plus the fact that it is not unusual for the level of such a drum to change ½ inch or so for no apparent reason. Half an inch on an 8-in. range with a maximum proportional band setting of 100% represents a large change in control valve opening, with a consequent large change in flow rate through the control valve.

Experience on many units indicates that an 8-in. ball float level controller, even when connected to the control instrument through a grease packed stuffing box, cannot be counted on to do any better job than is indicated by Chart L-1 in Fig. 5. In fact, Chart L-1 represents as stable a flow as has been seen from such an instrument. Charts L-2 and L-3, also in Fig. 5, which are taken from a similar process unit at another location are more typical of the unstable flows to be expected.

Process units currently being designed are being provided with either the differential type or the displacer type level controllers. The differential type utilizes a mercury manometer, bellows or force balance device to measure the level. The primary element of these devices are very similar to those used for flow measurement. The displacer type utilizes a relatively long tubular member which is so weighted that it always tends to sink. The measurement of level in such a case is made by weighing the tubular displacer member and calibrating the instrument directly in terms of level.

These two types have proven satisfactory where the ball float has not. The difference is considered to be due to (1) ability of the instrument to pick up changes in level that the ball float did not pick up and, (2) ranges are kept long as compared to the short ball float travel, such that a level change of ½ inch represents a much smaller change in control valve position. In effect, this latter point is equivalent to saying that the proportional band in terms of inches of level had been widened enormously. In addition, where the ball float instrument was usually limited to 100% proportional band, instruments

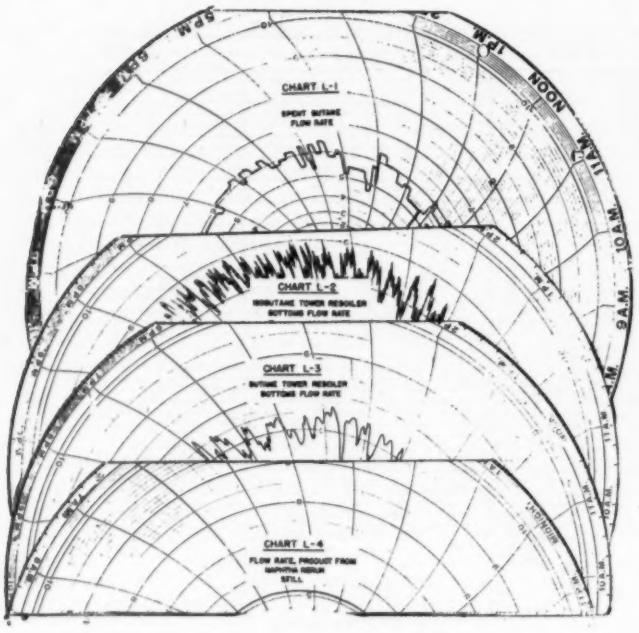

Fig. 5—Flow rate charts, indicating unstability of some of the flow rates experienced. Good results in Chart L-4 brought about through use of a long range differential type level controller in place of a ball float type instrument

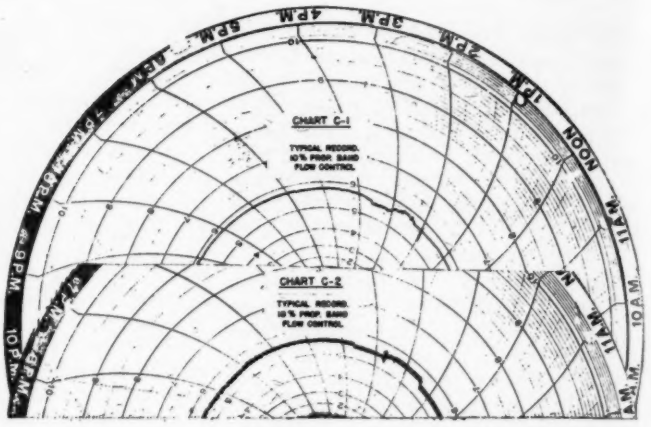

Fig. 6—Flow control records obtained at Aruba using proportional control only

on current jobs have adjustments which go to several times this value.

The excellent results obtainable with the differential and displacer types are typified in Chart L-4 in Fig. 5. This flow chart was obtained on an application in which a ball float type instrument was replaced by a long range (36 in.) differential type, due to inability of the ball float equipment to give stable flow.

CONTROL ACTION

For control of continuous processes a discussion of types of control action required is always of interest. Examination of the charts and of the record of changes uncovers the following points.

Flow Control: The flow controllers on the Aruba unit were of the mercury manometer, pneumatic transmission type, with proportional control action. Reset was not originally included but the tabulation shows that reset was added to the three circuit flow controllers. Charts C-1 and C-2 in Fig. 6 are typical of the results obtainable with proportional control alone. Such results are not perfect flow control. The offsetting of the record occurs when load or pressure changes take place. Such offsetting is inherent when proportional control is used alone. The minimum proportional band setting in such cases is approximately 10%. In order to obtain stable non-cyclic flow control with such a narrow proportional band, it is necessary to severely restrict the opening of the adjustable needle valve in the mercury manometer connecting U tube. This naturally impairs the responsiveness of the metering portion of the control installation, but the U tube cannot be opened further without a larger proportional band setting being required for non-cyclic control, with consequent larger offsets. For an unrestricted U tube, the required setting was found to be in the range of 40 to 60%.

Thus, for "compass circle" flow control, with or without a restricted U tube, reset is essential. For an unrestricted U tube reset must be employed or offsets will be so large they will destroy any semblance of the flow record to flow control. Since obtaining this field experience in 1939 and 1940 all flow controllers have been specified with reset.

Level Control: In theoretical discuscussion of level control the point is sometimes made that with any given set of conditions, and with proportional control only, the stability of flow through the valve will suffer somewhat if reset is added. This is readily apparent when it is considered that with a low level, for instance, the action of the reset is to close the valve beyond what the proportional control calls for, in order to drive the level back to the set point.

As mentioned, this is a theoretical point. Thus, it is of interest that the tabulation in Table 1 under "liquid level, rerun tower reflux drum" indicates that the point was demonstrated. The original application incorporated proportional plus reset action. The comment is "due to action of automatic reset, the alkylate flow to storage was unstable, even with slowest reset rate. Results satisfactory after change to proportional control only."

In view of the above, the comment under "liquid level, isobutane tower reboiler" may be confusing. The original equipment was identical to the level controller on the rerun tower reflux drum. The flow record, as in the rerun tower reflux drum application, was not sufficiently stable. The correction, however, was quite different. An instrument was used which retained reset, but incorporated proportional band adjustability to approximately 1500%. It is unfortunate that flow charts are unavailable to show flow stability obtained before and after the change. The recorded observation in the tabulation of Table. 1 plus records of the butane tower operation show that the change produced the required flow stability. Any consideration of this type of instrument must be tempered with the thought that as soon as the level deviates 4 ins. from the set point (mid-point of instrument range) the limit stops come into use, with the resultant large change in flow rate.

Fundamentally, although the changes to the two level control installations referred to produced a desired corrective action, the ball float equipment, with its short range of 8 ins. accentuates level control to the detriment of flow stability and does not take advantage of the storage which is built into the process equipment. To the level controller, only that storage within its range is usable. The remainder is unused. The fundamentally correct approach, used in subsequent designs, is to accent flow stability by allowing the level to vary within the full height of the storage by means of instruments with a range equal to storage limits, and large proportional bands.

Acknowledgement

This paper was presented at the Second National Instrumentation Conference, Chicago, Sept. 8-12, 1947.

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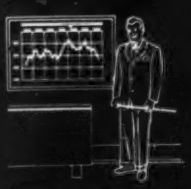

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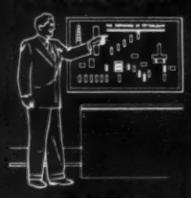

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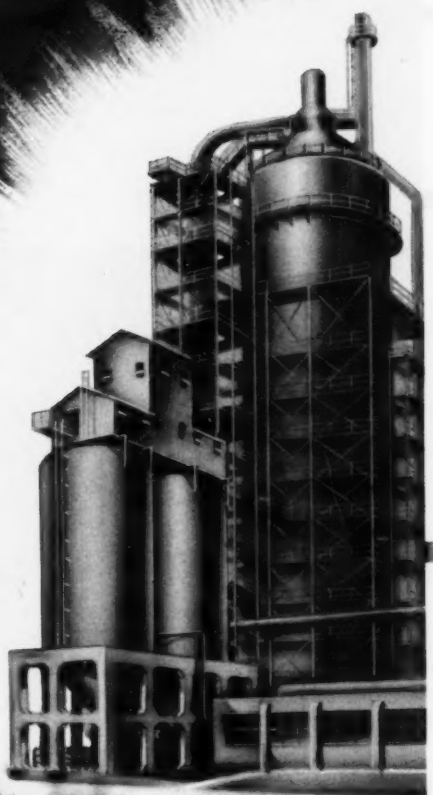

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BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

Patent Trends in Petroleum Refining

By PETER J. GAYLOR

Patent Attorney and Editor "The Technical Survey"

Thermal Cracking

THE INTRODUCTION of catalysis in cracking operations has reduced thermal cracking to a secondary operation at the present time. It is true that considerable research has been done in the thermal field and numerous patents have issued on upside-down, right side-up, and other modifications, none of which appear to line up competitively with catalytic under present conditions. However, it is felt that the thermal cracking field may still offer some promise, either due to new types of cracking stocks, economic conditions, or to unique operations not heretofore considered, and hence new ideas on this subject are worthy of consideration.

One of the more recent patents which claims superior results over former thermal cracking methods is U. S. 2,437,439 issued to E. H. Records of Tacoma, Wash. The patentee devotes a good portion of his specification in discussing his theory explaining the differing nature of various crudes in the ground, presumably caused by underground heating and distillation by volcanic heat. In accordance with his deductions, he has tried to simulate favorable underground conditions by a cracking assembly such as that shown in Fig. 1.

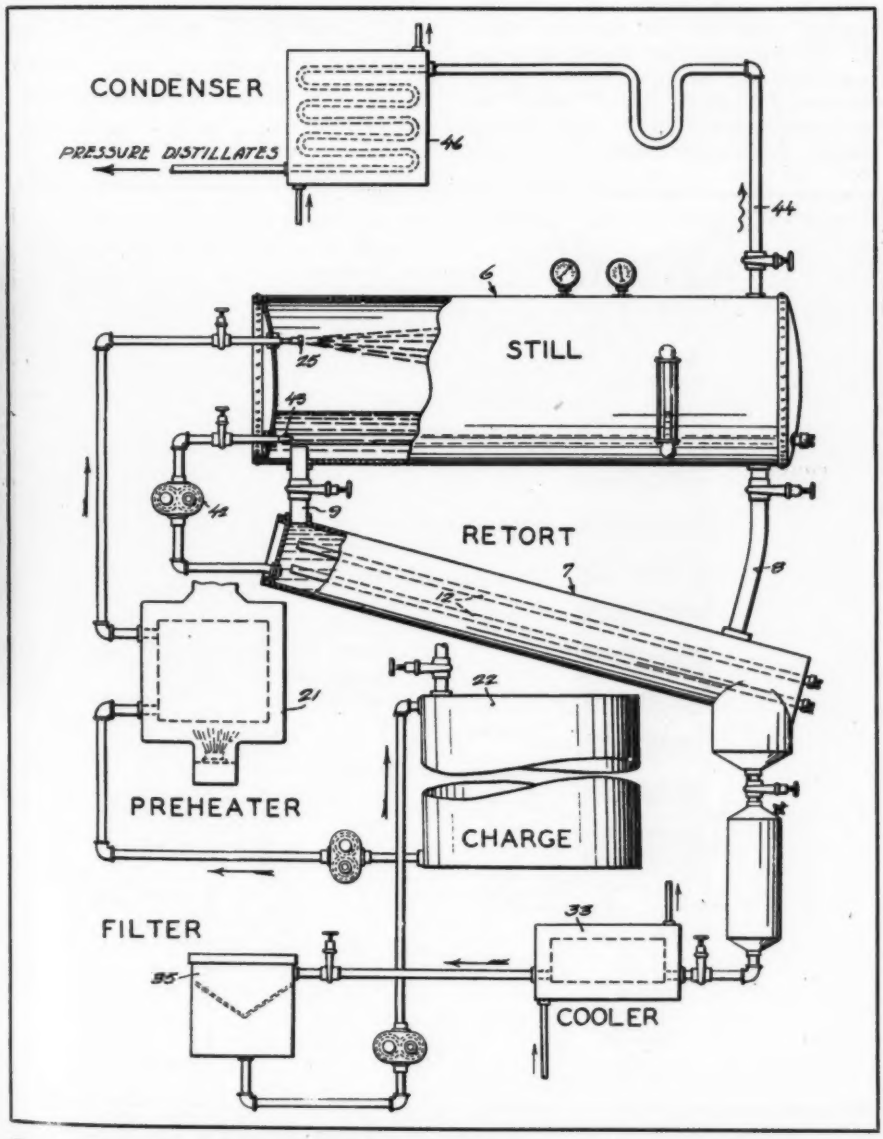

Fig. 1—Thermal cracking process devised to simulate underground conditions, and for which considerably increased yields are claimed. (U. S. 2,437,439)

In this operation, crude from reservoir 22 is pumped through preheater 21 and atomized into still 6 through nozzle 25. Beneath still 6, and connected to it by pipes 8 and 9, is diagonally disposed retort 7 provided with internally mounted electrical bayonet heaters 12. Pump 42 is used to expedite circulation of oil from retort 7 into still 6 through nozzle 43.

Distillation and cracking taking place in still 6 under about 200 psi. and 630° F. result in liberation of vapors, which are drawn off as "pressure distillates" through pipe 44 and condenser 46. The bottoms in retort 7 are cooled in cooler 33, filtered in 35 and pumped into charge tank 22 for recirculation.

By this operation, the inventor claims that he is able to obtain a 98.5% recovery of "pressure distillates" of 42.9° gravity and 0.7% sulfur from Santa Maria crude of 16.2° gravity and 4.42% sulfur, when customary recovery is about 45% from this crude.

Heat Stable Catalysts

UNION OIL CO., in its U. S. patent 2,437,533, describes a method for producing heat-stable catalysts useful for hydroforming, desulfurization, etc. It has found that the inclusion of small amounts of silica on or in the carrier (such as alumina), such carrier having distended on it a compound of chromium, vanadium, molybdenum or cobalt, has the effect of greatly improving heat stability, thus improving mechanical strength upon calcination, as well as the active life of the catalyst.

This is particularly true in the case of silica when the silica has been included in the catalyst carrier composition consisting primarily of activated alumina. Compositions containing 1-15 wt. % of silica and 85-99 wt. % of alumina have been found to be excellent carriers on which may be distended 1-45% of the oxides of cobalt and molybdenum in the molar ratio of 0.5 to 5 mols of cobalt oxide to 1 mol of molybdenum oxide.

Solvent Extraction

IN ORDER to avoid emulsion troubles in liquid-solvent extraction of hydrocarbons, Shell Development Co. (in its U. S. Patent 2,383,768) discloses the use of calcium naphthenate

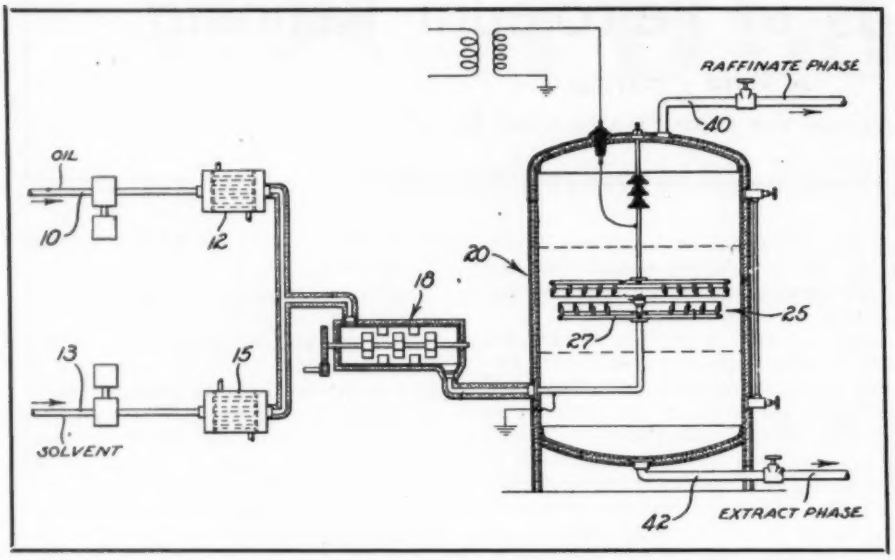

Fig. 2—Flow diagram for an electric solvent refining process recently disclosed by Petrolite Corp. (U.S. 2,395,011)

during the extraction operation. About 0.01% to 1% by weight of the soap is sufficient to increase the rate of separation of the liquid hydrocarbons from the solvent.

An electric solvent refining process for petroleum is disclosed by Petrolite Corporation in its U. S. Patent 2,395,011. The dispersion of the two liquids (in which the selective solvent has a dielectric constant more than twice that of the oil) is separated into two phases by subjecting it to the action of a high voltage alternating field in a manner similar to that shown in Fig. 2. There, the oil 10 and solvent 13 are heated in exchangers 12 and 15 and mixed in agitator 18, after which the dispersion is allowed to flow in the center of treater 20 between plates 27 bearing electrodes 25, and the emulsion is broken down to produce films which separate, the extract phase (nitrobenzene in this case) dropping to the bottom and being drawn out of pipe 42, while the raffinate phase rises to the top and is drawn off through line 40.

Catalytic Isomerization

USE OF ALUMINUM chloride catalyst in conventional isomerization processes is claimed to cause formation of fluid sludge which tends to flow downwardly over the catalyst, tending to coke or fuse the catalyst in place. Phillips Petroleum Co., in its U. S. patent 2,437,394, finds that it is able to avoid this difficulty by use of a moving catalyst system such as that shown in Fig. 3, wherein a primary and secondary chamber are employed.

The primary chamber 1 is packed with alternate layers of aluminum chloride catalyst 7 and Raschig rings 8. These are gradually withdrawn from the bottom of chamber 1 through valve 25, and replaced at the top, the catalyst layer being intermittently fed through valve 27 while the Raschig rings are fed through valve 26. The hydrocarbon feed stock to be isomerized is led into ceramic-lined chamber 1 through line 17 which allows entry into a space surrounding conical perforated funnel 5 through which the feed vapors are allowed to contact the catalyst.

The contacted vapors are led off the top of chamber 1 through line 18 and fed into the top of chamber 11 packed with inert packing material such as Raschig rings 10 resting on perforated plate 9. These vapors are withdrawn at the bottom of chamber 11 through line 19. Draw-off 16 is provided to drain off sludge and any other accumulated material.

Selected Patents

U. S. PATENTS issued from Mar. 9, 1948 to Mar. 23, 1948

U.S. 2,437,247 (Fischer)—Specific gravity indicator.
U.S. 2,437,258 (Amer. Chem. Paint Co.)—Isoprene esters.
U.S. 2,437,288 (Anderson) — Separating hydrocarbons and acidic gases.
U.S. 2,437,334 (Stand. Oil Dev. Co.)—Controlling chemical reactions, using powdered catalyst.
U.S. 2,437,348 (Univ. Oil Prods. Co.)—Refining hydrocarbon oil containing mercaptans.
U.S. 2,437,352 (Stand. Oil Indiana) — Catalyst recovery.
U.S. 2,437,356 (Stand. Oil Indiana)—Catalytic alkylation of aromatics with long chain olefins.
U.S. 2,437,357 (Union Oil Co.)—Solvent extraction of hydrocarbons.
U.S. 2,437,394 (Phillips Petr. Co.)—Isomerization.
U.S. 2,437,438 (Petroff and Prats) — Gasoline from coconut oil.
U.S. 2,437,439 (Records) — Converting petroleum crudes.
U.S. 2,437,531 (Union Oil Co.)—Catalytic conversion.

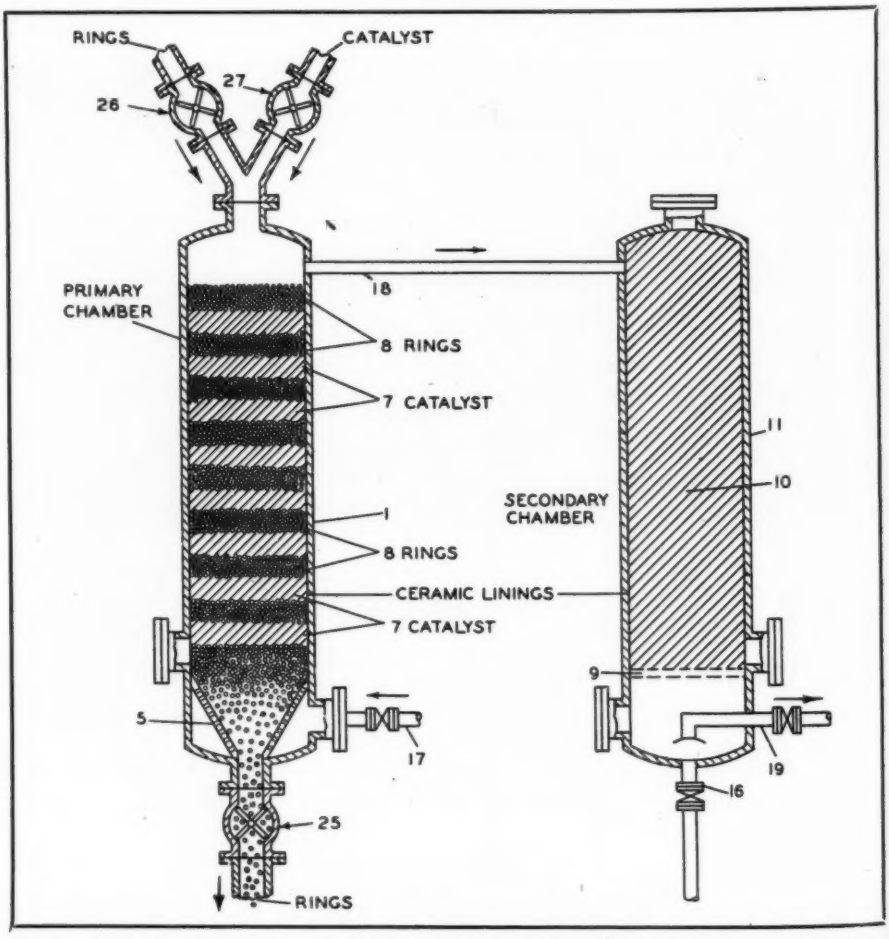

Fig. 3—Moving catalyst system devised by Phillips Petroleum Co. to avoid the formation of fluid sludge when using aluminum chloride catalyst for isomerization. (U. S. 2,437,394)

Basis for the Design of Instrumentation For Automatic Control of Liquid Level

By HAROLD E. McCLATCHEY, Foster Wheeler Corp.

This article defines "Averaging Level Control" on a mathematical basis for outlining a method for determining the minimum length of the primary element —displacer float length or distance between differential manometer taps—and optimum settings of an ideal controller.

The author points out the advantage of proper sizing of the control valve and of having the proper valve characteristic (lift vs. flow) in the line. He also discusses the disadvantage of too high a throttling range in the controller—caused by the primary element being too small.

IN the design of instrumentation for automatic control of liquid level, it is useful to express a mathematical basis for sizing the primary element (i.e., travel of float, distance between differential manometer taps, or length of displacer type float).

If reset is required, it is also necessary to determine the proportional band and reset adjustment. It is the purpose here to derive this desired mathematical basis, and also to discuss the effect of proportional-plus-reset averaging control in producing cycles in the plant. The first section is devoted to 100% proportional band adjustment and no reset; the second section to proportional adjustment of more than 100% and a reset adjustment.

The term "averaging control" may be defined as averaging the outflow or the inflow against the liquid level, the level being controlled between upper and lower limits. In this article, output flow will be considered as the controlled flow.

The definition of "averaging control" used shall be that the maximum rate of change in the flow rate (outflow) shall not exceed a certain fractional part of the normal outflow. Expressed mathematically:

$$\frac{du}{dt} \Big/ Q_n \leqq v$$

where:

u = variable output rate of flow.
Q_n = normal rate of flow throughput.
v = fractional rate of change of u per minute, based on normal throughput.
t = time.

The following is the derivation of the formula involving:

H = minimum height of float, or distance between manometer taps.
A = cross-sectional area of surge vessel.
h = height of liquid level in surge vessel.
m = fractional upset in input rate.
$(1+m)Q_n$ = new rate of input.
v = (as defined above).
U = control valve capacity.
u = variable rate of flow in cu. ft. per minute.
K = a constant.

The assumptions are: 1—hydrostatic effect of height of liquid level is negligible on the output flow, 2—the control valve characteristic in the line is a linear one, 3—the proportional band adjustment is set at 100%, and 4—no reset is used. See Fig. 1.

Then:

$$u = Kh$$
$$K = U/H$$
$$u = (U/H)h$$

Assuming initial conditions balance, input will equal output, and input is equal to $fU = KfH$, where f = fractional part of U. Then instantaneously, the input is increased to $(1 + m)KfH$:

$$\frac{dh}{dt} = \frac{\text{Input} - \text{Output}}{A} = \frac{(1 + m)\,KfH - Kh}{A}$$

$$\text{and: } \frac{du}{dt} = K\frac{dh}{dt} = \frac{K}{A}[(1 + m)\,KfH - Kh]$$

du/dt is maximum (absolute value) immediately after upset, then:

$$h = fH$$

$$\text{and: } K = \frac{U}{H}$$

$$\frac{du}{dt}\ \text{max.} = \frac{U^2fm}{AH}$$

$$\frac{du}{dt}\ \text{max.} \Big/ Q_n = v = \frac{U^2fm}{AH} \Big/ Uf = \frac{Um}{AH}$$

$$\text{then: } H = \frac{mU}{vA} \quad \ldots\ldots\ldots \text{Equation 1}$$

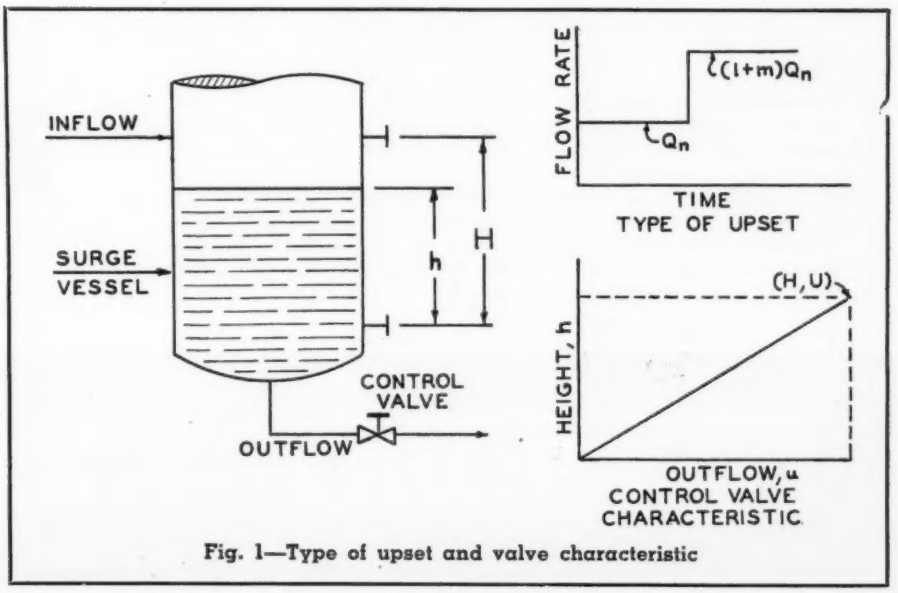

Fig. 1—Type of upset and valve characteristic

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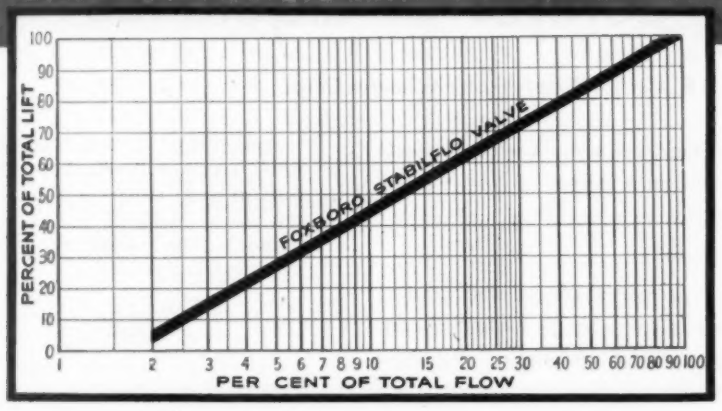

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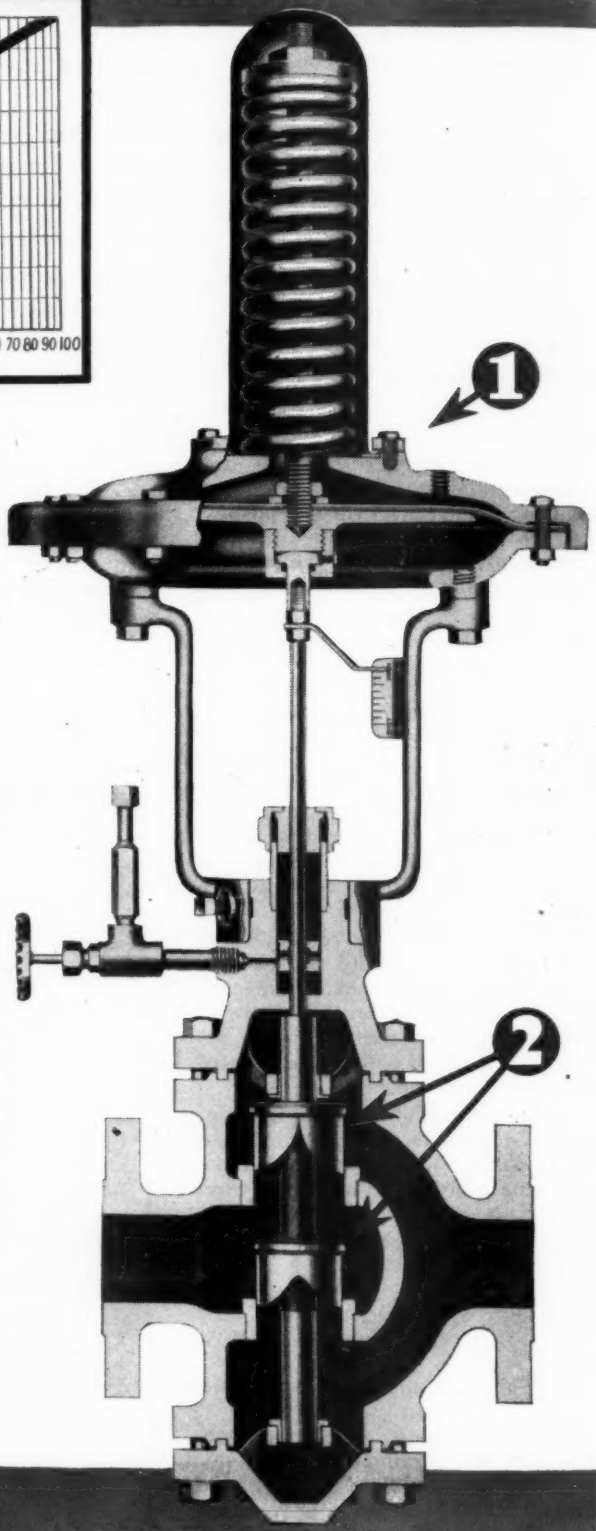

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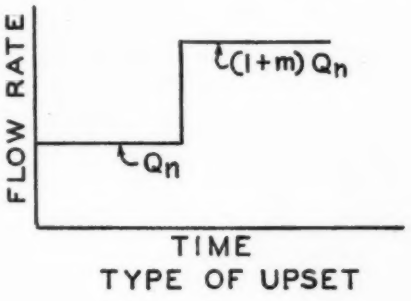
AUTOMATIC CONTROL VALVES

By inspection of Equation 1, it can be seen that the proper sizing of the control valve is quite important in keeping v below the maximum allowable limits. U (valve capacity) should not be over 50 to 100% more than the normal throughput.

The value of m should be determined by the average expected upset, rather than the upset to be expected during startup or shutdown of a plant.

The value of v should be determined by the requirements of the uniformity of output flow. Where the requirements of the uniformity of output flow are to be excellent, values of v recommended are from 0.01 to 0.02 per minute. For moderate uniformity, values of v recommended are from 0.02 to 0.04 per minute; and for unimportant or for accounting purposes, values of v recommended are from 0.04 to 0.06 per minute.

Equation 1 is based on the assumption that the valve characteristic in the line is linear; that is, it has a constant slope. The following derivation is based upon a poor installation, where the valve characteristic in the line is that of a parabola. See Fig. 2.



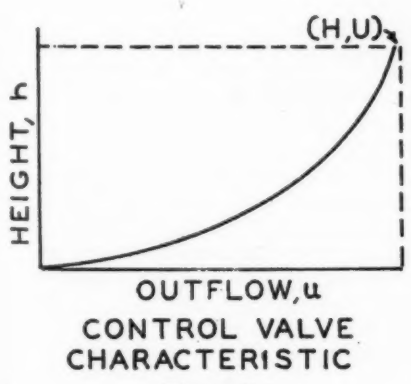


Figure 2

$$h = Ku^2$$

$$K = \frac{H}{U^2}$$

$$h = \frac{H}{U^2}u^2$$

$$\frac{dh}{du} = \frac{2H}{U^2}u$$

$$= \text{slope (S')}$$

At initial condition of balance, $h = fH$. Then $u = U\sqrt{f}$. After upset:

$$\frac{dh}{dt} = \frac{(1+m)\,U\sqrt{f} - U\sqrt{\frac{h}{H}}}{A}$$

$$\frac{du}{dt} =$$

$$\frac{1}{AS'}\left[(1+m)\,U\sqrt{f} - U\sqrt{\frac{h}{H}}\right]$$

du/dt is maximum when $h = fH$.

$$\frac{du}{dt}\text{ max.} = \frac{U\,m\sqrt{f}}{AS'}$$

$$= \frac{U^2\,m\sqrt{f}}{2AH\sqrt{f}}$$

$$= \frac{U^2\,m}{2A\,H}$$

$$\frac{du}{dt}\text{ max.}/Q_n = v$$

$$= \frac{Um}{2AH\sqrt{f}}$$

$$H = \frac{Um}{2A\,v\sqrt{f}} \quad \text{..... Equation 2}$$

As can be seen in Equation 2, the required height of float, or difference between manometer taps would depend upon the throughput. For design purposes, low values of f would have to be used. For the above reason a valve characteristic in the line should be a linear one.

The discussion so far has been based on no reset being used. If there is not space enough for the primary element according to Equation 1, or if it is necessary to keep the level at a prescribed point for process or safety purposes; then reset must be used.

The proportional band adjustment should be set so as to obtain the equivalent of H as obtained in Equation 1. For example: H in Equation 1 is calculated to be 20 ft., but 10 ft. are available. The proportional band, therefore, should be set at 200%. The reset adjustment should be set so that at the computed deviation from the normal level, or control point, the rate of change of output flow shall not exceed the value of v.

The derivation involving deviation from control point h, valve capacity U, cross-sectional area A, primary element length H, proportional band adjustment s, and reset setting r, after an upset, will now be given.

$$\frac{dP}{dt} = \frac{rh}{s} + \frac{1}{s}\frac{dh}{dt}$$

where:

P = position of control valve (lift).

s = throttling range in per cent divided by 100.

r = reset rate setting, which is also equal to number of times the proportional band is duplicated per minute.

h = deviation from control level, in ft.

u = variable output flow, in cu. ft./min.

U = maximum valve capacity, in cu. ft./min.

A linear valve characteristic in the line is assumed. Effect of reset is $(Urh)/(Hs)$. Effect of proportional band is $(U/Hs)\,(dh/dt)$.

$$\frac{du}{dt} = \frac{Urh}{Hs} + \frac{Udh}{Hsdt} \quad \text{... Equation 3}$$

In any vessel after instantaneous increase in the input flow:

$$\frac{dh}{dt} = \frac{Q_n\,(1+m) - u}{A}$$

$$\frac{d^2h}{dt^2} = -\frac{1}{A}\frac{du}{dt}$$

$$\frac{du}{dt} = -A\frac{d^2h}{dt^2}$$

$$\frac{d^2h}{dt^2} + \frac{K_p dh}{A\,dt} + \frac{K_r}{A}h = 0$$

..... Equation 4

where:

K_p = proportional band in cu. ft./min./ft.

K_r = reset rate in cu. ft./min./ft./min.

$= K_p r$

A = cross-sectional area of vessel in sq. ft.

The solutions of Equation 4 are three-fold. **Case I;** when $U/4HsA > r$:

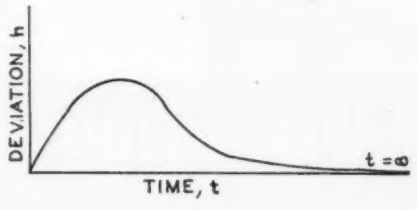


Figure 3

Case II; when $U/4HsA = r$:

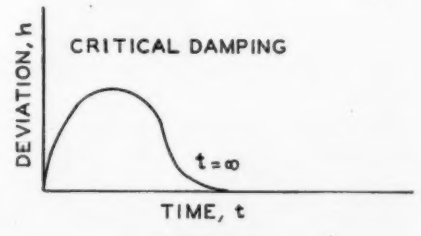


Figure 4

in the

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Case III; when $U/4HsA < r$:

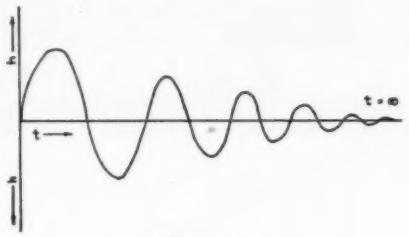

Figure 5

Case III is the usual case in averaging control.

$$h = \frac{Q_s m}{A\beta} e^{-\frac{K_p t}{2A}} \sin \beta t \quad \text{Equa. 5}$$

$$\frac{dh}{dt} = e^{-\frac{K_p t}{2A}} \times \left[\beta \cos \beta t - \frac{K_p}{2A} \sin \beta t \right] \frac{Q_s m}{A\beta}$$

$$u = Q_s (1 + m) - \frac{Q_s m}{\beta} e^{-\frac{K_p t}{2A}} \left[\beta \cos \beta t - \frac{K_p}{2A} \sin \beta t \right]$$

Time for one cycle $T = 2\pi / \beta$.

$$\beta = \sqrt{\frac{Kr}{A} - \frac{K_p^2}{4A^2}} = \sqrt{\frac{Ur}{AHs} - \left(\frac{U}{4AHs} \right)^2}$$

The value h is maximum when t in equation:

$$\beta \cos \beta t = \frac{K_p}{2A} \sin \beta t$$

satisfies this equation for values of:

$$\beta t \equiv \frac{2\pi}{4}$$

or an approximate solution for h maximum may be had by solving for t in:

$$t = \frac{\pi}{2\beta} \times 0.9$$

then substituting in Equation 5, and solving for h maximum.

Values of r less than 0.02 are not practical. Values of r will have to be determined by trial and error. When h is maximum, $dh/dt = O$, and du/dt can be determined by Equation 3.

$$\frac{du}{dt} / Q_s$$

of course must be less than or equal to v.

It is to be noted that Equation 5 is an equation of a sinusoidal wave of decreasing amplitude. If the value of $K_p/2A$ is small, cycling of output flow may become objectionable. To determine if this is so, let

$$t = \frac{\pi}{2\beta}$$

and:

$$t = \frac{3}{2} \frac{\pi}{\beta}$$

in:

$$e^{-\frac{K_p t}{2A}}$$

then determine ratio:

$$e^{-\frac{K_p \pi}{4A\beta}} \Big/ e^{-\frac{3K_p \pi}{4A\beta}}$$

This ratio will determine amplitude ratio of ¼ cycle amplitude to ¾ cycle amplitude.

It is not recommended to have H too small, necessitating throttling ranges above 400 or 500%. In using large values of s, r will have to be made large to keep the level within limits. See Equations 3 and 5. Excessively large values of s will make the time for one cycle short, and the amplitudes at ¾ and 1¼ cycles will not be much less than at ¼ cycle.

Summary

To determine the length of the primary element, Equation 1:

$$H = \frac{mU}{vA}$$

should be used. If there is sufficient room available, and the level does not have to be kept in the center of the vessel, or in the center of H. A controller set at 100% throttling range and no reset will provide the best averaging control. This system will not produce hunting or cycling of its own, but will always tend to absorb fluctuations in the input without hunting.

If there is not space enough for H, then reset will have to be used. To understand the action of throttling range and reset in a controller, Equation 3 should be examined thoroughly.

Throttling ranges greater than 400% should not be used. In using such a setup, serious hunting may be produced by the controller itself.

The constructive criticisms and suggestions of Messrs. David Hostedler, Roy Salmon, and Bernard Gilligan, Petroleum Refinery Division, Foster Wheeler Corp., are gratefully acknowledged.

References

Mathematics of Surge Vessels and Automatic Averaging Control, by D. E. Mason and C. A. Philbrick, American Society of Mechanical Engineers Trans. 63, 7, 589 (1941).

Principles of Industrial Process Control, by D. P. Eckman.

Differential Equations, by A. Cohen.

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Fig. 1460—Iron Body Bronze Mounted "Master Pilot" Gate Valve, with screw ends, rising stem, bolted flanged bonnet and tapered solid wedge.

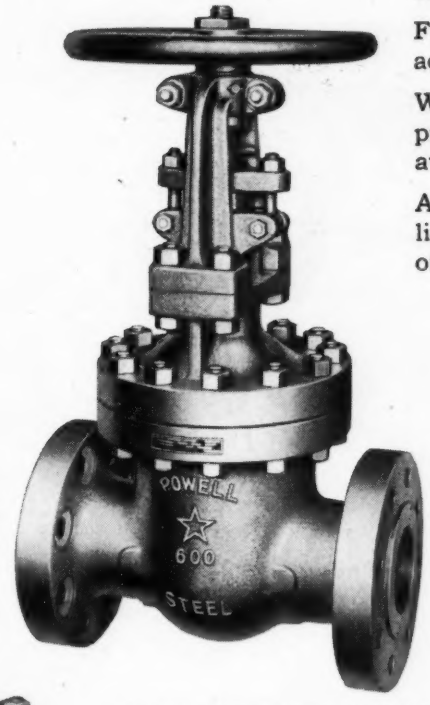

Fig. 6003—Class 600-pound Cast Steel Gate Valve with flanged ends, bolted flanged yoke, outside screw rising stem and tapered solid wedge.

Fig. 1561—Class 150-pound Cast Steel Swing Check Valve with flanged ends and bolted cap. Disc has ample lift to permit full straight-way, unobstructed flow through valve body.

Fig. 375 — 200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable, wear-resisting "Powellium" nickel-bronze disc.

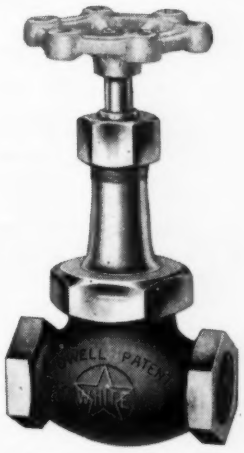

Fig. 1708—200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable specially heat treated stainless steel seat and regrindable, renewable wear-resisting "Powellium" nickel-bronze disc.

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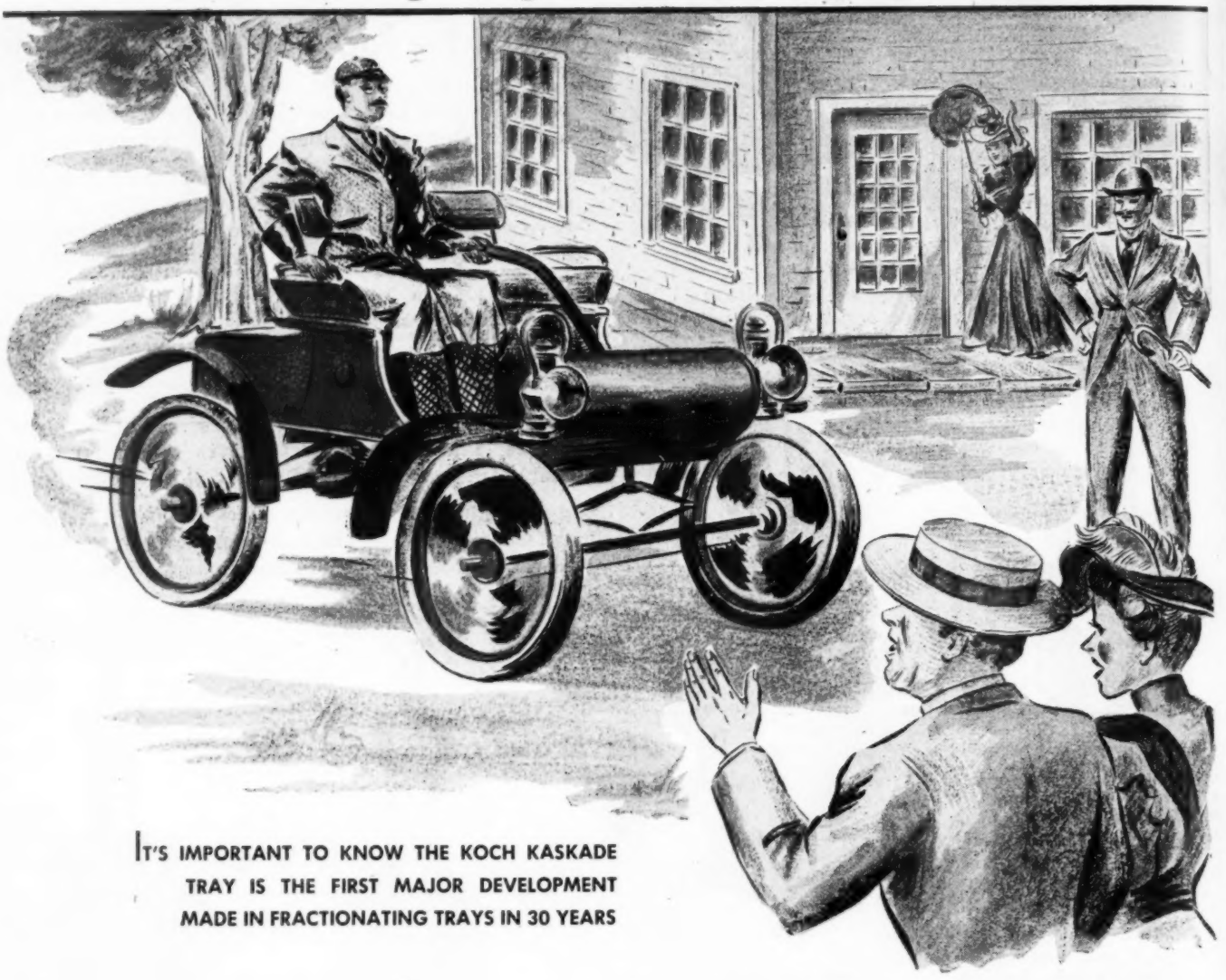
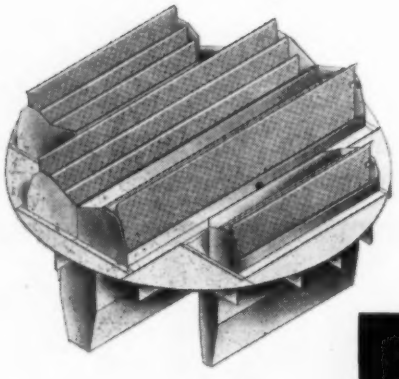


IT'S IMPORTANT TO KNOW THE KOCH KASKADE TRAY IS THE FIRST MAJOR DEVELOPMENT MADE IN FRACTIONATING TRAYS IN 30 YEARS



Compared to the standard type bubble tray, the Koch Kaskade Tray has 35% to 50% greater capacity, approximately 25% better efficiency, and is less subject to surging and flooding. Plant tests have proved the Koch Kaskade Fractionating Tray to be the best commercial device for vapor-liquid contacting, also a most excellent device for liquid-liquid contacting.

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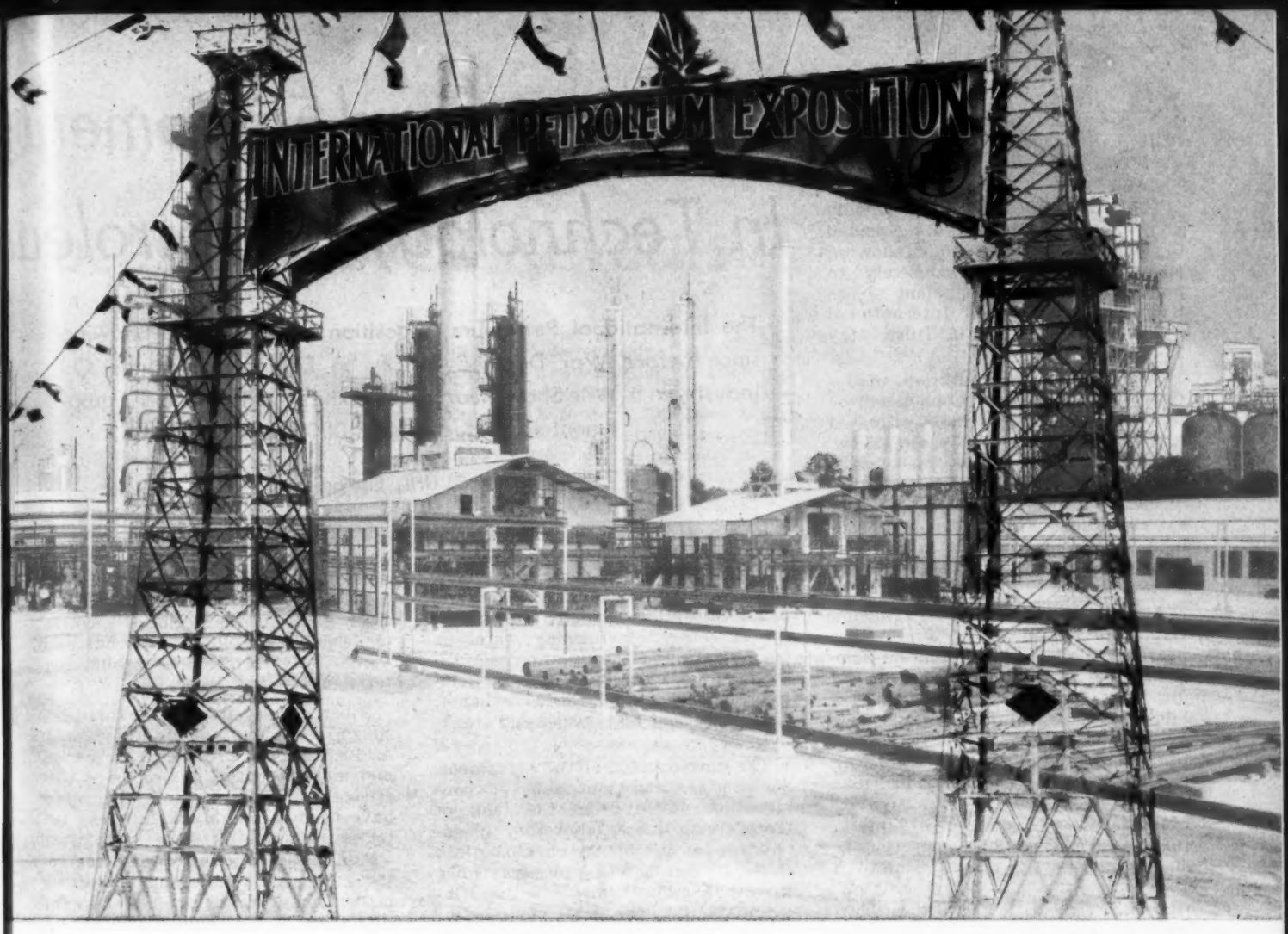


Petroleum Processing's Special Section Previewing

The Silver Anniversary

INTERNATIONAL PETROLEUM EXPOSITION

Tulsa, Oklahoma, May 15-22, 1948

New, Improved Equipment Is Dominant Factor in Progress in Technology of Petroleum Processing, Expo Reveals . . . Pages 458-459

Map of Exposition Grounds and Buildings . . . Pages 460-461

Directory of Refinery Equipment Exhibitors . . . Pages 463-496

Special Reply Card for Obtaining more Information about Products Being Exhibited . . . Opposite Page 496

New, Improved Equipment In Technology of Petroleum

The International Petroleum Exposition is First Public Showing since before War Devoted Strictly to Equipment for the Oil Industry; It Will Show nearly 200 Exhibits Of Refining Equipment to Expected 200,000 Visitors

By WILLIAM C. UHL, Equipment Editor

NEW and improved processing equipment has been a predominant factor in the rapid progress made in petroleum technology during the past eight years.

This fact will be brought vividly home to the 200,000 visitors expected to attend the first public showing since 1940 devoted exclusively to petroleum industry equipment — the Silver Anniversary International Petroleum Exposition in Tulsa, May 15-22.

Nearly 200 manufacturers of refinery equipment and supplies will be represented among the estimated 525 exhibitors at this year's show. Almost all of them have made valuable contributions to the nation's refiners in meeting the problem of spiralling demand for petroleum products, it was brought out in a recent survey made by PETROLEUM PROCESSING.

A preview of the Tulsa Petroleum Exposition, based on this survey, appears in this issue, beginning on page 463. It is in the form of a special directory of refinery equipment exhibitors, in which the various new products are described briefly. Among the many notable and interesting items scheduled for display in Tulsa are:

1. Advances in the design, fabrication, and use of alloy-clad vessels, shapes, and the like.

2. Expanded applications for stainless steel and other alloys in valves, fittings, pipe and tubing, sheets, and various accessories.

3. Powered lift trucks for handling all kinds of objects and materials, useful in refinery maintenance and in warehousing of raw materials and finished products.

4. Small steam turbines for many prime-moving jobs.

5. High pressure valves for corrosive service, incorporating welded bonnets and integral seats.

6. Micro flow control valves for precise work, such as in pilot plants.

7. A spherical-shaped plug valve which is said to reduce the effect of line pressures on the ease of operating the valve.

8. Rapid-action recorders and controllers for plant processing units.

9. Welding fittings of all types in stainless steel and other alloys.

10. Intricate forgings for all kinds of complex valves and special shapes.

11. Continuous blending apparatus —instruments, proportioning valves, and proportioning pumps.

12. Electronically-operated control and recording instruments.

13. Storage tank vapor saving devices, gages, and samplers.

14. Overhead spray deflectors and other improvements in fighting oil fires with foam.

Many of the important processes so commonplace in today's petroleum refineries have come into widespread use since the last International Petroleum Exposition was held. To mention a few—cycled, or continuous, Houdry catalytic cracking; TCC and Fluid catalytic cracking; hydroforming or catalytic reforming; catalytic isomerization; HF alkylation; several sweetening methods, Tannin Solutizer, Unisol, caustic soda-methanol; Hypersorption; and Suspensoid cracking.

The development of the equipment, accessories, and materials of construction essential to the task of transferring these laboratory brainchildren of petroleum chemists into full-scale commercial processes called for considerable "know-how" and ingenuity during the years since 1940.

Equipment manufacturers worked hand-in-hand with refinery engineers, mechanics, and operators, instrument designers, metallurgists, and many others to provide the needed devices and materials.

Alloys

A notable achievement in the field of construction materials was the increased adaptation of alloys to new applications. For example; back in the spring of 1941, the clad steels began to find their place in refining. Rather than apply alloy linings to vessels, engineers fabricated the structures from plates and sheets in which the thin layer of more expensive alloy was already bonded to ordinary carbon steel.

Stainless "W" was a marked improvement in alloys for refiners, developed during the war as a material combining the advantages of 18-8 alloy with others. Another alloy, 27%-chromium-iron, went into a large number of catalytic dehydrogenation units for the manufacture of butadiene from butane.

Glass and Plastics

Two other materials which have found satisfactory employment in petroleum processing are fibrous glass and plastics. Two plastics, saran and nylon, have been used as pipe linings for anti-corrosion service at the lower temperatures. Nylon and other plastics have been developed for satisfactory use in valve seats and discs for pumps and compressors handling sour crudes, brines, and the like. Nylon has been combined with fiber glass in the form of gaskets; while polytetrafluorethylene has been successfully formed into gasket material also.

Fiber glass tower packing has shown its advantage in the case of acid coalescers in several refineries, and more recently it is reported that crude oil desalters using fiber glass have been in operation. In these latter units, crude oil mixed with wash water passes at controlled temperatures through a contactor containing beds of the fibrous glass packing. The tiny fibers act as emulsion breakers.

Spun glass fibers have also been combined with synthetic and natural rubber in manufacturing high-pressure steam hose. Both synthetic rubber and other plastics have been used as linings for concrete gasoline storage tanks.

Carbon has been combined with plastics also. It has found use in the form of tower packing in alkali scrubbers for sulfur removal, in the form of a 70-ft. tower in a Cottrell precipitator at one plant, and in the form of so-called impervious graphite heat exchangers for service not exceeding 60 psi. and 350° F.

Laboratory Instruments

Another example of new equipment aids for refiners is in instruments for research and control laboratories —mass spectrometers, polarographs, infra-red and ultra-violet spectroscopes, electron microscopes, and X-ray diffraction apparatus.

The mass spectrometer, which makes accurate quantitative analyses in from 25 minutes to two hours, has been used in assaying high purity products, in controlling fractionating towers, alkylation and isomerization units, and in following many complex petro-chemical reaction processes.

Routine analyses by means of the infra-red spectroscope reportedly have an accuracy within about 0.5% of total sample and require only 15

t Dominant Factor in Progress
ur Processing, Expo Reveals

to 20 minutes to complete. Some designs of this instrument have been adapted to the automatic control of fractionator columns.

Spectroscopes

The ultra-violet spectroscope is somewhat similar to the infra-red, but generally is less expensive, has more limited applications, and requires less delicate recording apparatus. It is widely used and is perhaps the most common spectroscope installed in oil industry laboratories since 1940. It is especially suited for routine process control involving unsaturated hydrocarbons, such as the aromatics (styrene, naphthalene, toluene), acetylenes, diolefins, and compounds which have conjugated double bond systems. The paraffin hydrocarbons do not absorb ultra-violet radiation appreciably.

X-Ray Diffraction

The X-ray diffraction technique is usable largely on substances with crystalline structures, such as minerals and catalysts. The electron microscope, relatively new to the industry, as yet is found generally only in the larger research laboratories. It serves to magnify as does the ordinary optical instrument, but can "see" photographically objects 0.00001 mm. in diameter, while the limit of the light microscope is 0.0001 mm. Its use is in studies of catalyst structure and surface, grease fibers, and metallic and other surfaces.

A purely chemical procedure is the polarographic method of determining the concentration of substances. Of late it has been employed in determining the presence of naphthalenes in crude petroleum and products. Traces down to 1×10^{-6} gram-molecules per liter may be detected.

Control Instruments

Control instrumentation for plant processes has likewise made great advances in the eight years since the last Petroleum Exposition. The difficulties during the early days of controllers—"hunting" processing variables—has been largely overcome. So-called rapid-response devices, the adoption of electronic mechanisms, and other new techniques have made possible controllers of almost human characteristics.

Radioactive substances have also been adapted for use by the petroleum industry. One major oil company's invention, the "Penetron", serves as a means for measuring thickness of metal from one side only, and as a result has been incorporated into a useful inspection tool for checking vessels, tubes, and the like. A form of this same device, the "Gagetron", detects the level of liquid within a tank or reaction vessel with no internal mechanism needed.

Modified Spray Tower

A very new development in a field allied to fractionation is a modification of the spray tower permitting an application to problems in solvent recovery, gas absorption and desorption, direct evaporation, and gaseous heat transfer.

This new tower has been developed as a less expensive method than conventional spray towers, bubble trays, ceramic saddle-packed towers, and beds of solid absorbents. The "Multi-Drop" tower in operation may be likened to the familiar spray cooling tower for water with countercurrent flow of liquid from the top and air from the bottom. It can be constructed of any material from ferrous and non-ferrous metals to wood, and can operate under conditions of pressure, atmosphere, or vacuum.

Automatic Blending

A further indication of the trend toward automatic processing is the development of automatic continuous blending devices, useful for manufacture of gasoline stocks, compounding lube oil stocks and greases, and addition of anti-knock fluid and other additives to petroleum products. This very significant advance has been made possible through accurate proportioning pumps, valves, and the auxiliary controls operating through such variables as flow volumes, weights, and the like.

Proportioning systems fall generally into two classifications: 1) *flow responsive,* in which the largest component, or major fluid, controls the rates of all secondary ingredients, and 2) *constant rate,* which may be either continuous or a timed batch proposition, in which the entire system is "paced" by a synchronous motor arrangement.

Heat Exchangers

A number of new things have been learned and incorporated into heat transfer apparatus in the past eight years. Changes in design of the location and shape of baffles inside heat exchangers is one example of a comparatively recent improvement. It was found that by arranging baffles in a vertical catalyst cooler so that the cold oil flow passed more directly over the tube sheets, it was possible to counteract the usual high temperatures encountered at that point and reduce distortion and failure.

The problem of scarce cooling water in the Southwest during the summer drouths led to the development of satisfactory air-cooled heat exchangers which are used during the daytime heat to supplement the heavy load on existing conventional water-cooled towers.

Fire Protection

Fire protection, always a problem of major economic consideration, also benefitted by wartime developments. One example is the use of "Navy Bean Soup," the so-called mechanical foam, which requires only one material to be added to the stream of water. In its most convenient-to-use form, it is furnished in five-gallon cans and picked up by an aspirator type nozzle at the end of the fire hose. Extensive tests by government and industrial officials at a large oil tank farm "proving grounds" a year or two ago showed the material to be very satisfactory.

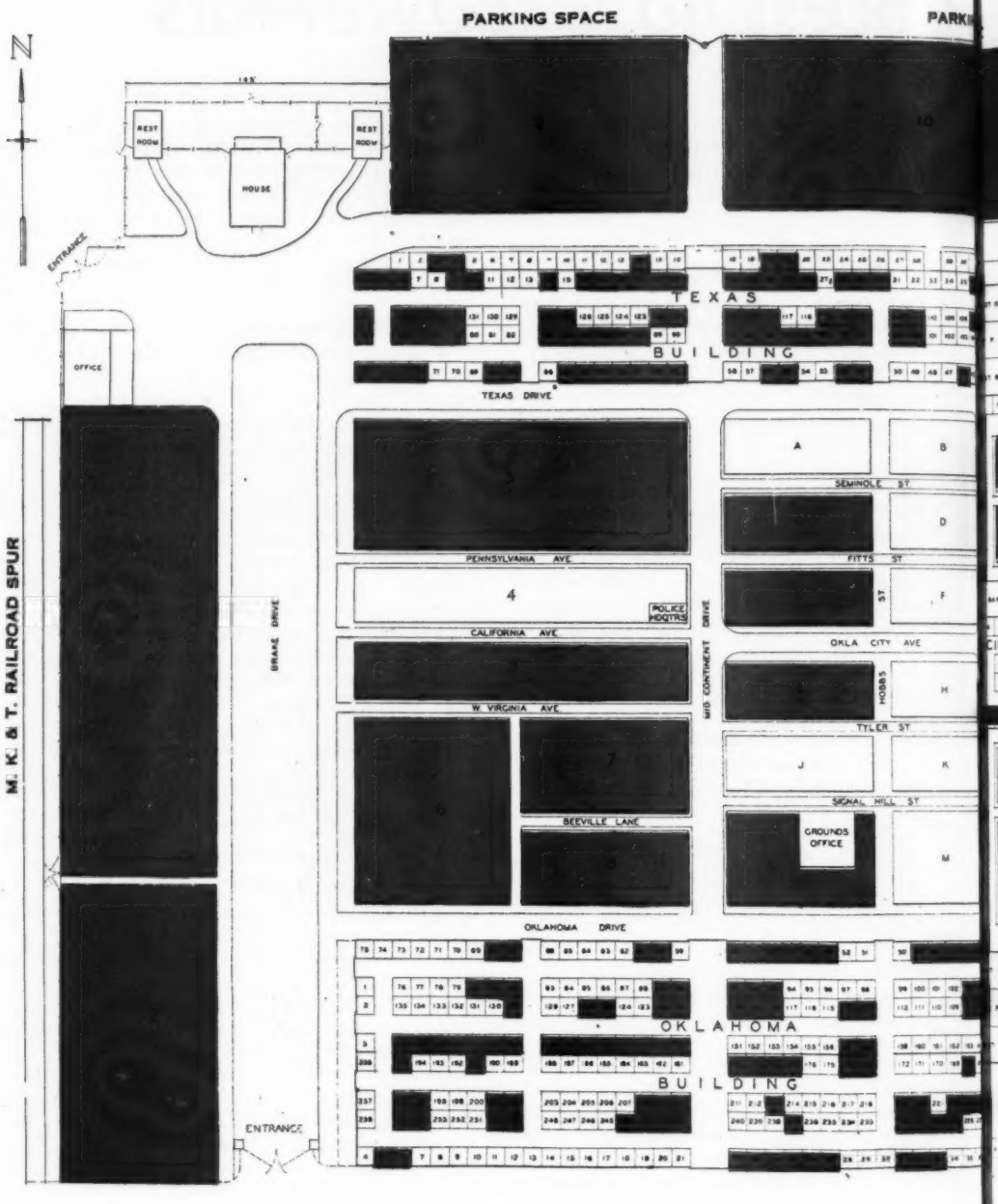
A patent issued a little over a year ago covers a method for easy installation of a foam system in a storage tank area. Ordinarily, foam systems have required putting in a new and separate piping system to feed the fire-fighting material to the top of the tank. In this patent, foam is fed into the bottom through the existing discharge line already in place for the tank contents. Tests are reported to have indicated success with this method.

Material Handling

The use of powered lift trucks is another example of existing industrial equipment being adapted to use around petroleum refineries. These small and powerful materials-handling tools have proved to be time and money-savers on a variety of jobs in plant maintenance. Truck manufacturers have developed a number of accessories ideally suited for transporting the odd-shaped, cumbersome loads involved in repairs on processing units.

In addition, the practice is increasing of installing permanent overhead monorails on plant units to help speed up turnarounds. Tube bundles, heavy slide valves and motor-operated valves can be lifted out of position with a minimum of effort.

MAP OF EXPOSITION GROUNDS AND DIRE



Texas Building

Booth Nos.	Company Names
1-2:	Wm. Powell Co.
4-6:	Pittsburgh Steel Co.
14:	Durametallic Corp.
16-17:	American Air Filter Co.
18-21:	WKM Co., Inc.
22-23:	Oakite Products, Inc.
24-26:	Chapman Valve Mfg. Co.
28-30:	Ridge Tool Co.
36-37:	Grove Regulator Co.
38-39:	Black & Decker Mfg. Co.
46:	Magnus Chemical Co.
51-52:	C. Lee Cook Mfg.
55-56:	American Bosch Corp.
59-60:	Garlock Packing Co.
64-65:	International Nickel Co., Inc.
67-68:	SKF Industries, Inc.
72:	France Packing Co.; France Mfg. Co.
73-75:	Koppers Corp.; Wailes Dove-Hermiston Corp.
76-79:	Chase Brass & Copper Co.; Fischer Governor Co.; Ohio Steel Foundry; Vinson Supply Co.
83-84:	Automatic Control Div., Climax Industries, Inc.; Climax Engineering Co.
85-86:	Chicago Bridge & Iron Co.
87-88:	Jarecki Mfg. Co.
91-93:	Mission Mfg. Co.
94-95:	Armstrong Machine Wks.
96-100:	E. I. DuPont de Nemours & Co.
106-107:	Dearborn Chemical Co.
111-115:	E. I. DuPont de Nemours & Co.
118-120:	Mission Mfg. Co.
121-122:	Lufkin Rule Co.
127-128:	Automatic Control Div., Climax Industries, Inc.; Climax Engineering Co.
132-133:	Tube Turns, Inc., Div. of Girdler Corp.
134-135:	Chase Brass & Copper Co.; Fischer Governor Co.; Ohio Steel Foundry; Vinson Supply Co.

Oklahoma Building

Booth Nos.	Company Names
5-6:	General American Transportation Co.
22-27:	Byron-Jackson Co.
31-33:	Air Reduction Sales Co.
38:	C-O-Two Fire Equipment Co.
39:	Pyrene Mfg. Co.
42-43:	American Recording Chart Co.
45-47:	Johns-Manville
48-49:	Mine Safety Appliances Co.
53-58:	Oildine Div., Allis-Chalmers Mfg. Co.
60-61:	Industrial Controller Div., Regulator Div., and Switch & Panel Div., Square D Co.
67-68:	Lunkenheimer Co.
80-81:	Vapor Recovery Systems Co.
82:	Johnston & Jennings Co.
89-90:	Kerotest Mfg. Co.
91-93:	Westinghouse Electric Corp.
103-108:	Walworth Co.
113-114:	Darling Valve & Mfg. Co.
118-120:	Westinghouse Electric Corp.
121-122:	Kerotest Mfg. Co.
125-126:	Elliott Co.
129:	Johnston & Jennings Co.

Oklahoma Building (continued)

136-148:	U. S. Steel Corp.; American Bridge Co.; American Steel & Wire Co.; Carnegie-Illinois Steel Corp.; Columbia Steel Co.; Cyclone Fence Div.; National Tube Co.; Gerrard Steel Strapping Co.; Tennessee Coal, Iron and Railroad Co.
149-150:	Timken Roller Bearing
157-158:	American Chain & Cable Co.
168:	Nelson Electric Mfg. Co.
173-174:	American Chain & Cable Co.
177-180:	A. O. Smith Corp.
195:	Lukens Steel Corp.
196-197:	Crane Co.
201-202:	Lincoln Electric Co.
208-210:	American Brass Co.
213:	Keuffel & Esser Co.

Oklahoma Building (continued)

219-220:	Ohio Injector Co.
222:	Petroleum Engineering, Inc.
223-224:	Watson-Stillman Co.
229:	Steel Improvement & Forge Co.
230:	Manning, Maxwell & Moore
231-232:	Ohio Injector Co.
237:	Byron-Jackson Co.
239:	Proportioneers, Inc.
241-244:	General Electric Co.
249-250:	Lincoln Electric Co.
254-255:	Crane Co.

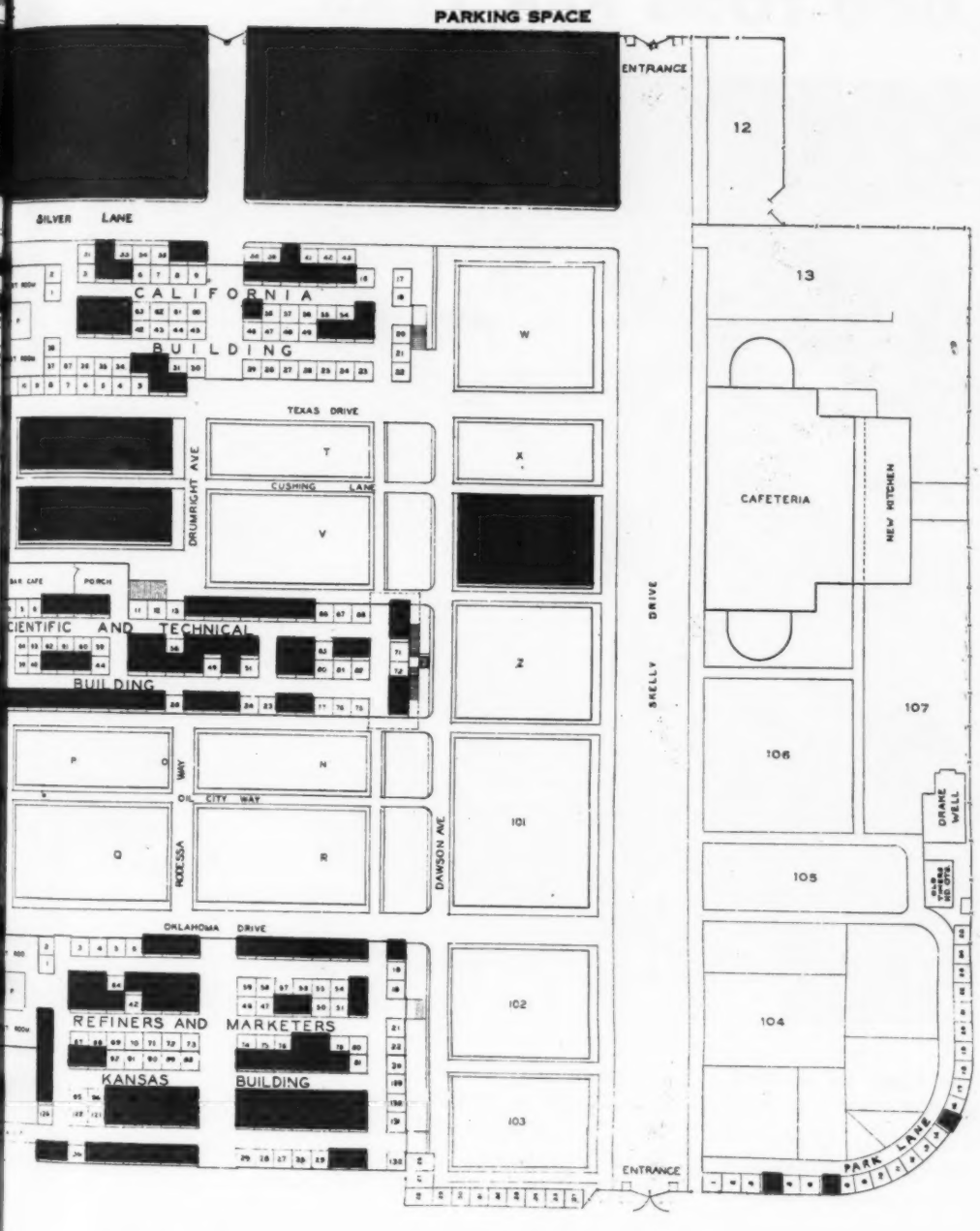
Numbered Blocks

Block Nos.	Company Names
1:	Jones & Laughlin Supply Co.; Jones & Laughlin Steel Corp.; Mid-West Piping & Supply Co.

Numbered Blocks (continued)

2:	Wilson-Snyder Mfg. Div., Oil Well Supply Co.
3:	American Car & Foundry Co.; Ludlow Valve Mfg. Co., Inc.; Mission Mfg. Co.
5:	H. K. Porter, Inc.
6-8:	Continental Supply Co.; Maxim Silencer Co.; Youngstown Sheet & Tube Co.
9:	Bethlehem Steel Co.; Bethlehem Supply Co.; Petro-Chemical Development Co.; Taylor Forge & Pipe Works
10:	Hyatt Bearing Division, General Motors Corp.
11:	Dresser Industries, Inc.; Pacific Pumps, Inc.; Roots-Connersville Blower Corp.

DIRECTORY OF REFINERY EXHIBITORS



Lettered Blocks

Block Letters	Company Names
C:	Trackson Co.
E:	Trackson Co.
G:	Cooper-Bessemer Corp.; Foote Bros. Gear & Machine Corp.
J:	Happy Co.
L:	Worthington Pump & Machine Corp.
S:	Armco Drainage & Metal Products, Inc.
U:	Braden Steel Corp.; Ingersoll-Rand Co.; Young Radiator Co.
Y:	Dowell, Inc.

Texas Drive

Booth Nos.	Company Name
1-2:	McNamar Boiler & Tank Co.

Silver Lane

Booth Nos.	Company Names
3-4:	John Zink Co.
14:	Formica Insulation Co.; Plastilite Engineering Co.; Service Engineers, Inc.
20-21:	American Roller Bearing Co.
32:	Farris Engineering Co.
36-37:	Pittsburgh Valve & Fittings Corp.
40:	Bailey Meter Co.

Park Lane

Booth Nos.	Company Names
4:	Oliver United Filters, Inc.
7:	Sterling Packing & Gasket
15;	Clark Mfg. Co.
26-28:	Hyster Co.

Scientific & Technical Building

Booth Nos.	Company Names
1-2:	Quigley Co., Inc.
7:	American Optical Co.
8-10:	Refinery Supply Co.
14:	Sparkler Mfg. Co.
15-16:	Bristol Co.
17:	Justrite Mfg. Co.
18-19:	Foxboro Co.
20-21:	Flint Steel Corp.
22:	Engineering Laboratories
25:	Fischer & Porter Co.
26:	E. H. Sargent & Co.
27:	Meriam Instrument Co.
29-30:	Leeds & Northrup Co.
31-32:	Taylor Instrument Co.
33-38:	Edward Valves, Inc.; Nordstrom Valve Co.
37-38:	Rockwell Mfg. Co.

Scientific & Technical Building

(continued)

41-43:	Brown Instrument Co. Div. of Minneapolis-Honeywell Regulator Co.
45-46:	American Meter Co.; Crosby Steam Gage & Valve Co.; Davis Regulator; Hammel Dahl Co.
47-48:	Fluor Corp., Ltd.
50:	National Lead Co.
52-55:	Aluminum Co. of America
57-58:	American Meter Co.; Crosby Steam Gage & Valve Co.; Davis Regulator; Hammel Dahl Co.
63-64:	Joseph A. Coy Co., Inc.
65:	Foxboro Co.
69-70:	Tret-O-Lite, Natasco Co.
73-74:	Universal Oil Products Co.
78:	Engineering Laboratories
79:	Beckman Instruments; National Technical Laboratories
83-84:	Smith Meter Co.
86:	Jerguson Gage & Valve Co.
87:	Taylor Instrument Co.

California Building

Booth Nos.	Company Names
4-5:	Mixing Equipment Co.
10-13:	Fairbanks Morse & Co.
14-15:	Chicago Pneumatic Tool Co.
32-33:	Ampco Metal, Inc.
39-41:	Black, Sivalls & Bryson, Inc.
50-51:	Fairbanks Co.
52-53:	Chiksan Co.
59:	Warner Lewis Co.
64-66:	Black, Sivalls & Bryson, Inc.

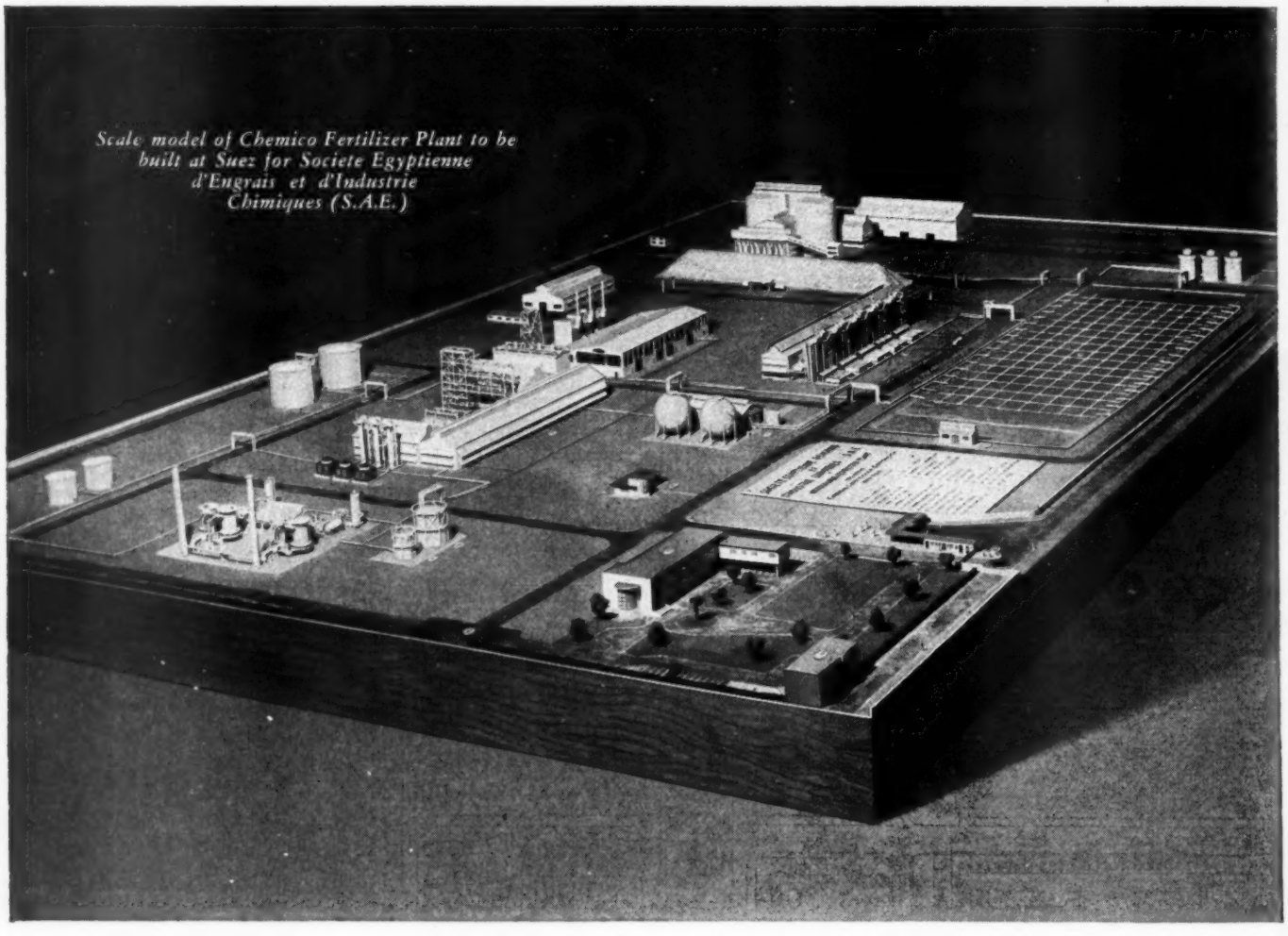
Kansas Building

Booth Nos.	Company Names
7-9:	Ladish Co.
10-16:	Hobart Bros.
17:	Cook Electric Co.
23-24:	Milton Roy Pump Co.
30-31:	Multi-Metal Wire Cloth Co., Inc.
32-35:	Harnischfeger Corp.
37:	Fairbanks Morse & Co.
38:	National Foam Systems, Inc.
39-40:	Nash Engineering Co.
41:	Airetool Mfg. Co.
43-45:	Tyson Bearing Corp.
48-49:	Louis Allis Co.
52-53:	Pfaudler
60-63:	Tyson Bearing Corp.
65-66:	Nash Engineering Co.
77:	Graver Tank & Mfg. Co.; Struther Wells Co.
78:	Marley Co., Inc.
82-87:	Kieley & Mueller, Inc.
93-94:	Bonney Forge & Tool Wks.
97-98:	Owens-Corning Fiberglas Corp.
99-101:	Republic Supply Co.
102-115:	Republic Steel Corp.
116-118:	Republic Supply Co.
119-120:	Owens - Corning Fiberglas Corp.
123-125:	Bridgeport Brass Co.
127-128:	D. W. Haering & Co., Inc.

NOTE: Because of late changes in space assignments, there may be some minor discrepancies between the directory of refinery exhibitors and the colored areas on the map.—Editor.

FERTILIZER *for* EGYPT

200,000 TONS PER YEAR



Scale model of Chemico Fertilizer Plant to be built at Suez for Societe Egyptienne d'Engrais et d'Industrie Chimiques (S.A.E.)

Destined to play a significant part in meeting Egypt's urgent need for fertilizer, this modern chemical plant will produce *550 tons of calcium nitrate every day* . . . nutrition for the starved soil of the Nile Valley.

This important Chemico project, now in the design stage, actually will include *three* plants in one . . . a Synthetic Ammonia Unit, a Pressure Nitric Acid Plant, and a Calcium Nitrate Plant. Still gases piped from oil refineries will provide hydrogen . . . air will furnish the nitrogen. Water will come from the Nile. Limestone will be hauled from quarries 20 miles distant. Chemico will also provide complete facilities for the production of power and process steam. The plant will operate continuously . . . almost automatically.

This fertilizer plant is but one of several similar large-scale projects on which Chemico is retained for design and construction. In Egypt, India, Mexico . . . in strategic places the world over . . . Chemico-built plants will help to meet the world's fertilizer needs.

CHEMICO
CHEMICAL CONSTRUCTION CORP.

CHEMICAL CONSTRUCTION CORPORATION

EMPIRE STATE BLDG., 350 FIFTH AVENUE, NEW YORK 1, N. Y.

EUROPEAN TECHNICAL REPRESENTATIVE
CYANAMID PRODUCTS, LTD., BRETTENHAM HOUSE, LANCASTER PLACE, LONDON W. C. 2, ENGLAND

EUROPEAN LICENSEE OF N. E. C. PROCESS
HYDRO-NITRO S. A., 8 QUAI DU CHEVAL BLANC, GENEVA, SWITZERLAND

CABLES: CHEMICONST, NEW YORK

"Chemical plants are profitable investments"

CC-163

Petroleum Processing's

DIRECTORY of REFINING EQUIPMENT

To Be Exhibited at the

INTERNATIONAL PETROLEUM EXPOSITION

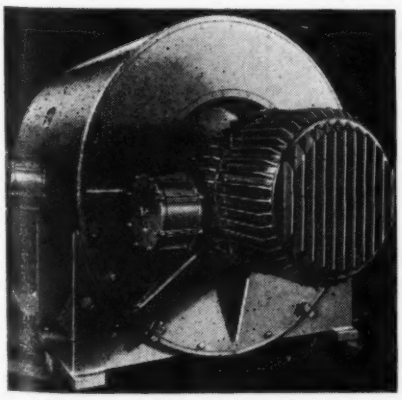
Exhibitors at the International Petroleum Exposition who will have displays of interest to the petroleum processing industry are listed below, alphabetically, with booth locations. Where the information has been made available, the listings include brief descriptions of what will be shown, particularly new items of equipment, materials and supplies. For the convenience of readers unable to attend the Exposition, additional information on any of these items can be obtained by using the special reply card in this issue, opposite page 496. The key numbers above each complete listing are to be used to identify the companies in requesting further information. Although every effort has been made to compile a complete and accurate directory, PETROLEUM PROCESSING assumes no responsibility for errors or omissions.

101

AIRETOOL MFG. CO.
Kansas Bldg., Booth 41

Will Exhibit: Single and double expansion type tube cleaners for both straight and bent tubes; "New Form" cutters which clean scale without tracking or damaging the tube; complete line of tube expanders; air, steam, and water driven motors will be demonstrated by a cutaway model; flycutters; combination boring and cutoff tools, inspection gages; calipers; and a Catalyst Removal system for vertical reactors of polymerization units.

New: Three models of outside-mounted cleaners for heat exchanger and condenser tubes in ⅜ to 2½ in range. These will include a direct drive, lightweight model, No. CC-450; and geared models.



Allis-Chalmers' 500 hp electric motor

Representatives: Thor Thornson, sales manager, in charge of booth.

AIR REDUCTION SALES CO.
Oklahoma Bldg., Booths 31-33

102

ALLIS-CHALMERS MFG. CO.
Oklahoma Bldg., Booths 53-58

Will Exhibit: Automatic self-priming pump; "Magic Grip Sheave" speed changer; centrifugal blower; 10,000 kw gas turbine; solids-handling pump; "Ampac 200" arc welder.

New: ANYZ electric motor for use in hazardous locations; 500 hp., 2300 volt, 3 phase, 60 cycle, 705 rpm. Following bulletins: O8B6319B on automatic self-priming pump, 25B6676 on Allis-Chalmers equipment for the oil industry, and 25B6150A on "More Power for the USA".

Representatives: S. A. Whitehurst, G. V. Pokorny, Harvey Reinhard, H. L. Clary, C. F. Codrington, C. A. Richardson, R. J. Enters, E. H. Fredrick, E. F. Boening, J. M. Anderson, and T. L. Pankey.

103

LOUIS ALLIS CO.
Kansas Bldg., Booths 48-49

Will Exhibit: Electric motors of types and specifications used extensively in the petroleum processing industry, including open, dripproof motors; explosion-proof motors; and splashproof motors.

Representatives: Louis Allis, Jr., vice-president, sales; C. G. Skidmore, sales manager; K. H. Boehmer, application engineer.

104

ALUMINUM CO. OF AMERICA
Scientific & Technical Bldg.
Booths 52-55

Will Exhibit: Aluminum pipe; welded joints and mechanical couplings; aluminum and magnesium galvanic anodes for cathodic protection of buried steel pipe lines and structures from corrosion; corrosion-protective aluminum paints for tanks, pipe, structures, and towers.

New: Insulated aluminum wire and cable, approved late in 1946 by the Underwriters' Laboratories, Inc. Chemicals Division of Alcoa will show a new ball form of tabular aluminum for use in pebble heaters and as a catalyst support, and will also show activated alumina for drying liquids and gases.

Representatives: B. J. Fletcher, chief engineer, Development Division, will be in charge of booth.

AMERICAN AIR FILTER CO.
Texas Bldg., Booths 16-17

For more information on these items, use reply card opposite p. 496.

AMERICAN BOSCH CORP.
Texas Bldg., Booths 55-56

105

AMERICAN BRASS CO.
Oklahoma Bldg., Booths 208-210

Will Exhibit: An operating demonstration of heat transfer properties of copper. One of the elements will employ the principles of the controversial heat pump, extracting heat from three mediums—air, earth, and water—and through two refrigeration cycles will produce both hot and cold air. Also to be displayed will be various copper alloys in form of heat exchanger tubes and tube sheets, seamless pump liners, piston finished pump rod, pipe, and fittings.

Representatives: D. E. Hotchkiss, H. F. King, W. H. Butterbaugh, H. F. Wallis, Glen Turner, and E. B. Brown.

AMERICAN BRIDGE CO.
Oklahoma Bldg., Booths 136-148

See listing under United States Steel Corp.

106

AMERICAN CAR & FOUNDRY CO.
Block 3

Will Exhibit: A line of plug valves; 2 in., 125 psi., screwed; 3 in., 250 psi., flanged; 16 in., 250 psi., venturi worm gear operated; 3 in. steel, series 300; 2 in. semi-steel, 125 psi., screwed; and 2 in. 150 psi., steel, screwed.

AMERICAN CHAIN & CABLE CO.
Oklahoma Bldg., Booths 157-158, 173-174

107

AMERICAN METER CO.
Scientific & Technical Bldg.
Booths 45-46, 57-58

Will Exhibit: Indicating, recording, and control instruments for refineries, natural gasoline plants, cycling plants, pipe lines, etc.

108

AMERICAN OPTICAL CO.
Scientific & Technical Bldg.
Booth 7

Will Exhibit: Safety goggles for chipping and welding, chemicals, and dust; welding helmets; hand shields; face shields; respirators; and safety clothing.

New: Chippers' goggles, and a new respirator.

Representatives: R. P. Welch, H. G. Bourne.

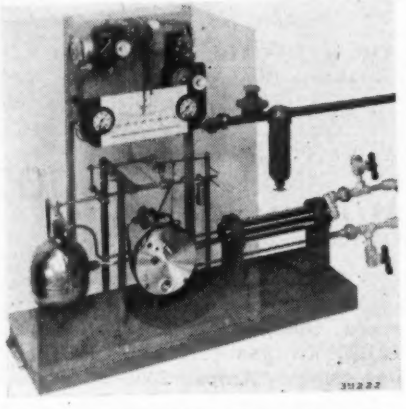
109

AMERICAN RECORDING CHART CO.
Oklahoma Bldg., Booths 42-43

Will Exhibit: Arrco "Dry-Air" Gas Gravitometer, recording Liquid Gravitometer, recording controlling liquid gravitometer, mercuryless meter, and controlling viscosimeter.

New: Arrco-Anubis Recording Controlling Liquid Gravitometer which features a controlling mechanism that can be preset to operate the pipe line, refinery, still, or plant control valves to any specific gravity range required in blending two or more products to a predetermined final specific gravity.

Representatives: J. W. Dunn, W. R. Gay and T. H. Cody.



American Recording Chart Co.'s Controlling Liquid Gravitometer

AMERICAN ROLLER BEARING CO.
Silver Lane, Booths 20-21

AMERICAN STEEL & WIRE CO.
Oklahoma Bldg., Booths 136-148

See listing under United States Steel Corp.

110

AMPCO METAL, INC.
California Bldg., Booths 32-33

Will Exhibit: Centrifugal pumps made of corrosion-resistant aluminum bronze; fabricated assemblies; bronze castings; extruded rod; rolled sheet.

Representatives: S. E. Lawson, ass't gen'l sales manager, in charge.

111

ARMCO DRAINAGE & METAL PRODUCTS, INC.
Armco Steelox Bldg., Block S

Will Exhibit: Spiral welded pipe; equipment for lining up the pipe, field coating and wrapping procedure, and wrinkle bending; quick-coupling pipe; guardrail; steel buildings; and tanks.

Representatives: R. C. Beam, R. E. Walker, R. O. Hayes, S. R. Ives, H. D. Neill, R. K. Leedom, W. H. Spindler, C. G. Hiskey, R. E. Farquhar, E. H. Holland, G. H. Klouman, Paul Weinman, W. F. Elliott, R. L. Wells, Jr., C. J. Coleman, and J. W. Scofield.

112

ARMSTRONG MACHINE WORKS
Texas Bldg., Booths 94-95

Will Exhibit: Inverted bucket steam traps, side or bottom inlets, for low, medium, high, and extremely high pressures, screwed or flanged connections; compound steam traps in capacities up to 300,000 lbs./hr.; traps for pulsating pressures; gasoline-water separator traps; foul gas purgers.

New: A glass demonstration model of the No. 812, 250 psi. trap, operating on steam at 7 psi.

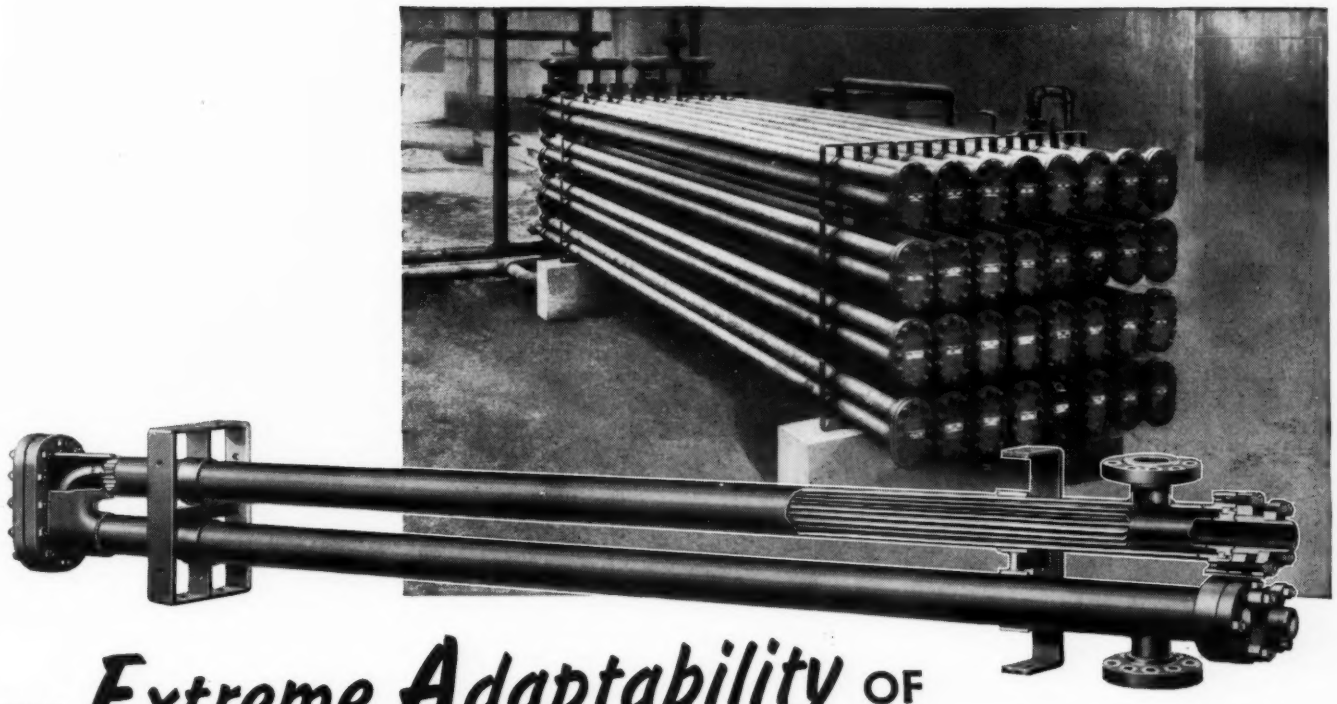
Representatives: O. E. Ulrich and Walter B. Allan.

113

BAILEY METER CO.
Silver Lane, Booth 40

Will Exhibit: Electronic type instruments. An Area Type Fluid Flow Meter will be installed in a water system to demonstrate its sensitivity to small flows and small changes in rate. A Two-Pen "Pyrotron," employing both a thermocouple unit and a resistance element will be measuring room temperature. Its rapid action will be shown by grasping the element. An Oxygen Analyzer and Recorder will be used to measure the percentage of oxygen consumed in

For more information on these items, use reply card opposite p. 496.



THE *Extreme Adaptability* OF

BROWN FINTUBE SECTIONAL HAIRPIN HEAT EXCHANGERS

Enables users to keep production abreast of changing market and seasonal conditions

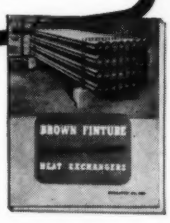
● Unlike "bundle" type exchangers, which are custom built for a definite and fixed duty, Brown Fintube Sectional Hairpin Heat Exchangers give operating men almost unlimited flexibility to meet changing requirements. The capacity of the bank can be increased by adding additional sections to the original installation. Capacity can be decreased by valving off one or more of the parallel streams,—or reducing the number of sections in each stream. The entire bank can be changed from one duty, to another and totally different duty, by remanifolding the sections in different series-parallel arrangement. And the bank can even be disassembled, and the sections then reassembled as two or more smaller exchangers on different duties, in different plants.

Let us help you in adapting Brown Fintube Sectional Hairpin Heat Exchangers—with their many outstanding operating and maintenance advantages—to your next heat transfer requirement. The Brown Fintube Co., Elyria, Ohio. Sales engineers in the principal cities.

8 ADVANTAGES

BROWN FINTUBE
Sectional Hairpin
HEAT EXCHANGERS

1. Flanged Shell Seal and Flanged Union Head End Assembly.
2. Extreme Adaptability to Meet the Requirements of Changed Duties.
3. No Obsolescence.
4. Easy Inspection and Maintenance
5. Continuous Operation. No Shut Downs for Servicing.
6. Minimum Investment in Replacement Parts.
7. The Brown Resistance Welded Integrally Bonded Fintube.
8. Easily Removed Rear End Cover Plate.



Write today for Bulletin No. 481. It gives full details

BROWN FINTUBE

Sectional Hairpin

HEAT EXCHANGERS

RESISTANCE WELDED INTEGRALLY BONDED FINTUBES AND FINTUBE HEAT TRANSFER PRODUCTS

Your Invitation

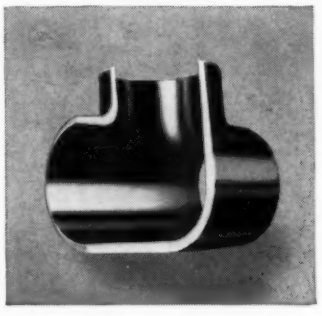
TO EXAMINE THE
LADISH *Controlled Quality* LINE

ON DISPLAY, BOOTHS 7-8-9 KANSAS BLDG.
INTERNATIONAL PETROLEUM EXPOSITION
TULSA, OKLAHOMA

INSPECT THESE LADISH DEVELOPMENTS THAT INCREASE PIPING EFFICIENCY

NEW SEAMLESS REDUCING ELBOW

Saves space.
Saves welding cost.
Eliminates an extra fitting.
Improves flow efficiency.



NEW TAPER DESIGNED TEE

Scientific metal distribution.
Increased strength.
Reinforced crotch.
Full branch outlet.

Controlled Quality
FITTINGS

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

DISTRICT OFFICES New York • Buffalo • Pittsburgh • Philadelphia
Cleveland • Chicago • St. Louis • Atlanta • Houston • Los Angeles

SEAMLESS WELDING FITTINGS

TO MARK PROGRESS

Carbon, Stainless and Alloy Steels. Complete Range of Sizes and Types—½ through 30 inches.

FORGED STEEL FITTINGS

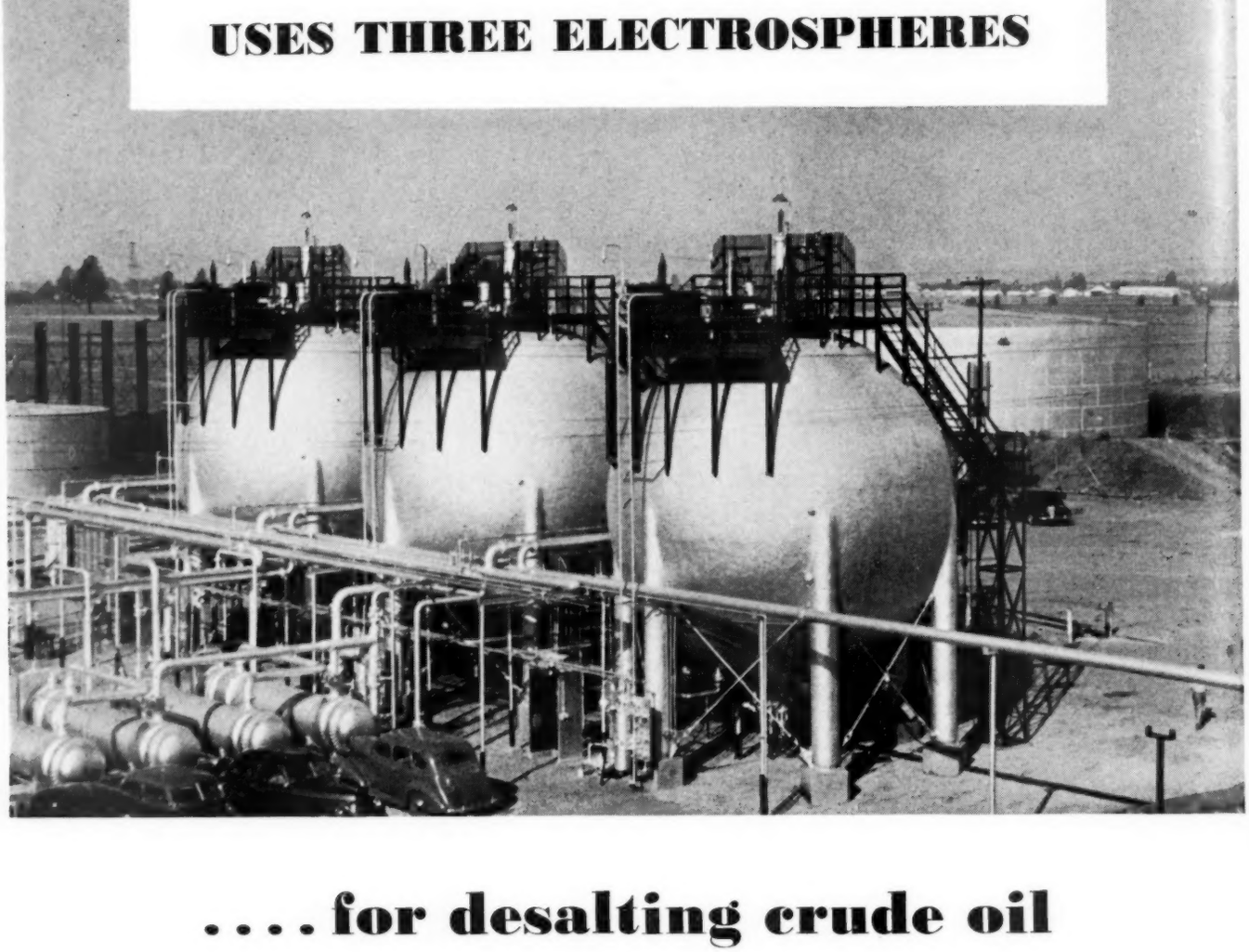
Screwed and Socket Welding. Carbon, Stainless and Alloy Steels. Complete Range of Sizes and Types—⅛ through 4 inches, 2000 through 6000 pounds.

FORGED STEEL FLANGES

Carbon, Stainless and Alloy Steels. Complete Range of Sizes and Types — ½ through 30 inches.

A COMPLETE LINE PRODUCED UNDER ONE ROOF
... ONE RESPONSIBILITY

WEST COAST OIL COMPANY
USES THREE ELECTROSPHERES



. . . . for desalting crude oil

The charging of salt-bearing crudes into refining units seriously affects their efficiency and output. To remedy this situation, the Union Oil Company had a Petreco electric desalting unit, designed by Petroleum Rectifying Company, installed at its Santa Maria, Calif., pumping station to treat crude delivered to its Oleum refinery.

The salt-bearing crude passes through heat exchangers, is mixed with hot, fresh water and pumped to the desalters. The mixture flows through an emulsifier and then into the Electrospheres where it is distributed into a high-voltage electric field. This causes the separation of the oil and water, and thereby effects the removal of the major part of the salt in the oil.

The desalting facilities make it possible for the refining units at Oleum to perform efficiently at constant maximum throughput.

The three Electrospheres at Santa Maria, illustrated above, are specially designed Chicago Bridge & Iron Company Hortonspheres built according to API-ASME specifications. The transformers, which are located on top of the spheres, are shown clearly in this view.

CHICAGO BRIDGE & IRON COMPANY

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

Chicago, 4.....2114 McCormick Bldg.
New York, 6.....3310-165 Broadway Bldg.
Cleveland, 15.....2215 Guildhall Bldg.
Los Angeles, 14.....1426 Wm. Fox Bldg.
Atlanta, 3.....2103 Healey Bldg.
Birmingham, 1.....1527 North 50th St.
Tulsa, 3.....1620 Hunt Bldg.
Houston, 2.....2130 National Standard Bldg.
Philadelphia, 3..1630-1700 Walnut Street Bldg.
Havana.....402 Abreu Bldg.
San Francisco, 11..1208-22 Battery Street Bldg.
Detroit, 26.....1532 Lafayette Bldg.

REPRESENTATIVES AND LICENSEES

Chicago Bridge & Iron Company, Limited, Apartado 1348, Caracas, Venezuela
Ateliers et Chantiers de la Seine Maritime, Paris, France
Constructions Metalliques de Provence, Arles-sur-Rhone, France
Leopoldo Sol & Cia., Reconquista 558, Buenos Aires, Argentina
Horton Steel Works, Limited, Fort Erie, Ontario, Canada
Whessoe, Limited, Darlington, England
Motherwell Bridge & Engineering Company, Limited, Motherwell, Scotland

normal breathing. Diagrammatic drawings will illustrate 1) automatic control for an alkylation heat medium furnace, 2) air-naphthalene ratio control, 3) combustion control on oil and gas-fired furnaces for a large refinery.

New: Following bulletins; 150 on Combustibles Recorder, 151-A on Oxygen Recorder, 230-B on Resistance Thermometer, 232-A on Poteniometer Pyrometer, 233 on Area Meter, 234 on pH Recorder, and 17 on Controls for Process Industries.

Representatives: A. E. Albert and C. M. Kunkel, in charge of booth.

BECKMAN INSTRUMENTS
(National Technical Laboratories)
Scientific & Technical Bldg.
Booth 79

See listing under *National Technical Laboratories* for a description of the display.

114

BETHLEHEM STEEL CO.
Silver Lane, Block 9

Will Exhibit: Relief valves; furnaces; welded fittings and flanges; hose and packing; malleable and forged steel screwed fittings; "Magnilastic" expansion joints; pressure gauges; photographs of tanks erected by the company.

Representatives: C. R. Zimmerman, E. A. Buxton, G. L. LaSchober, Jr., O. E. Berg, N. R. Downie, L. C. Torrell, T. J. Fitzgibbons, C. M. Mackall, B. C. McGregor, R. E. Burns, P. E. Anderson, V. A. Kelly, C. B. Hinton, L. H. Winkler, W. J. Taylor, A. P. Spooner, J. S. Worth, W. J. Pearson, R. S. Barnes, C. D. Meals, E. S. Gingrich, A. A. Warg.

115

BLACK & DECKER MFG. CO.
Texas Bldg., Booths 38-39

Will Exhibit: Portable electric drills, saws, hammers, sanders; electric bench grinders and pedestals; electric valve and valve seat reconditioning equipment for diesel engines and motor trucks.

Representatives: W. L. Poynter, R. H. Sorrels, Leon Moffett, A. Ralph Cooper.

116

BLACK, SIVALLS & BRYSON, INC.
California Bldg.,
Booths 39-41, 64-66

Will Exhibit: Valves, separators, safety heads, and a photographic display covering other products. Company will continue their previous practice of photographing friends and customers in the oil industry.

New: Model 70 Indirect Heater; Models CFJ and CFK Chemical Feeders.

Representatives: Ralph Stevens, H. B. Fessler, Vern Palmer, Lee Kelton, Floyd Myers.

117

BONNEY FORGE & TOOL WORKS
Kansas Bldg., Booths 93-94

Will Exhibit: "WeldOlet" forged fittings for branch pipe outlets; mechanic's hand tools.

New: Catalog on Forged Fittings.

Representatives: C. D. Otterson, vice-president & sales manager; F. S. Durham, Jr., vice-president & secretary; J. M. Potts, W. L. Duhig, R. H. Wixson, C. C. Miller, R. K. Cook, Matt Sproul, and Jean du Bois.

BRADEN STEEL CORP.
Block U

118

BRIDGEPORT BRASS CO.
Kansas Bldg., Booths 123-125

Will Exhibit: Condenser and heat exchanger tubing. Samples to illustrate the method of processing tubing from solid billets by the tube extrusion process. Samples of various alloys and their applications in refineries. A 28-ft. mural consisting of an oil painting of Bridgeport's casting shops and mills.

Representatives: A. R. Zender, vice-president, sales; Philip Davidson, advertising manager; C. L. Hancock, manager, condenser tube sales; H. E. Lee, G. C. Chatneuff, and F. S. Snedeker.

119

BRISTOL CO.
Scientific & Technical Bldg.
Booths 15-16

Will Exhibit: Operating displays of the following equipment; "Metavane" system of pneumatic telemetering distant measurement of temperature, flow, pressure, and liquid level; "Free-Vane" controllers for flow, temperature, liquid level, pressure, draft, humidity, pH, time programs; wide-strip "Dynamaster" resistance thermometers.

New: Series 500 air-operated controllers and recording pressure gages.

Representatives: H. E. Beane, gen'l sales manager; F. W. Borchers, ass't sales manager; C. E. Mason, technical director; E. L. Stilson, A. A. Blackman, W. Messner, and G. F. Lonergan.

BROWN INSTRUMENT CO.
Scientific & Technical Bldg.
Booths 41-43

120

BYRON JACKSON CO.
Oklahoma Bldg., Booths 22-27

Will Exhibit: "SM Process" stuffingboxless pump with a 36 hp., 2 pole, 440 volt, 60 cycle motor, 200 gpm capacity against a 350 ft. head. The pump has a steel case, an 11-13 chrome impeller, double mechanical seal, and neoprene isolating bag. A model made of aluminum of a double case boiler feed pump will be disassembled to show design features.

New: BJ "Bilt-on" pumps, close-coupled pump and motor units designed with interchangeable parts in a wide range of capacities.

CARNEGIE-ILLINOIS STEEL CORP.
Oklahoma Bldg., Booths 136-148

See listing under United States Steel Corp.

121

CHAPMAN VALVE MFG. CO.
Texas Bldg., Booths 24-26

Will Exhibit: A huge 50 in. steel slide valve designed for special service in Fluid catalytic cracking plants.

122

CHASE BRASS & COPPER CO.
Texas Bldg., Booths 76-77

Will Exhibit: Tubing in antimonial Admiralty copper, cupro-nickel, and bi-metal; red brass pipe; ventilated bus bar; copper hammers; copper nails; brass lag screws; silicon bronze bolts and nuts; bare copper wire; and magnet wire.

Representatives: H. P. Croft, W. J. Weir, W. E. Evans, L. J. Vogler, P. D. Evans, N. W. Mitchell, and J. J. Vreeland.

123

CHICAGO BRIDGE & IRON CO.
Texas Bldg., Booths 85-86

Will Exhibit: Tanks with Horton Double Deck floating roofs; tanks with Horton Lifter roofs; Hortonspheres; Hortonspheroids; Vaporspheres. The company will have a short section of an actual size seal for the floating roof; a 24-in. diame-

For more information on these items, use reply card opposite p. 496.

ter operating model showing the operation of a Vaporsphere and a slide projector showing views of various commercial tank installations.

New: The following booklets; Bulletin B, "Horton Double Deck Floating Roof;" Bulletin C, "Horton Lifter Roof;" Bulletin D, "The Vaporsphere;" Bulletin E, "The Hortonsphereoid;" Bulletin F, "The Hortonsphere."

Representatives: R. A. Jackson, sales manager; S. C. Hamilton, D. A. Leach, M. G. Mitchell, E. P. Shelton, and C. M. Orr.

CHICAGO PNEUMATIC TOOL CO.
California Bldg., Booths 14-15

124

CHIKSAN CO.
California Bldg., Booths 52-53

Will Exhibit: Complete line of ball-bearing swivel joints, wing unions, thread lubricants.

New: Forged joints; 12,000 psi. extra high-pressure joints; sanitary joints; improved steel rotary hose.

Representatives: W. Edgar Spear, president; L. J. Laird, vice-president and sales manager; H. J. Schlarb and Frank Wiegand, engineering sales; E. T. Landgraff, New York office manager.

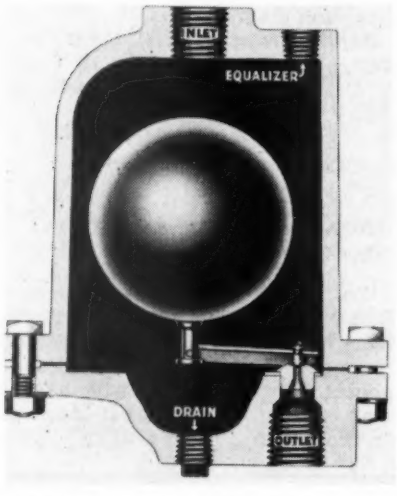
125

CLARK MFG. CO.
Park Lane, Booth 15

Will Exhibit: Steam, gas, oil, and air traps and separators; pressure regulators and reducing valves; strainers; liquid level controls; vacuum and lifting traps.

New: High pressure float trap designed particularly for reboilers.

Representatives: John L. Mainwaring, executive vice-president; W. P. Webster, sales manager; Henry Eggelhof, Robert Molnari, and Morley Hudson, of Eggelhof Engineers, Dallas, Texas.



Clark Mfg.'s high pressure float trap

126

CLIMAX ENGINEERING CO.
Texas Bldg., Booths 83-84, 127-128

Will Exhibit: Oil and gas separators; diaphragm control valves, Types 86, 15D, 32; liquid level controller, Type 850; drainers; pressure controllers; time cycle controllers; differential pressure regulators; back pressure regulators; LPG regulators.

New: Type 1515 diaphragm motor valve with reversible topworks, designed for use in pilot plants, sizes ¼, ⅜, ½, ¾, and 1 in., screwed globe only, working pressure, 3000 psi., at 100 F. Bulletins 101 on the Type 1400 Pressure Controller and 105 on Diaphragm Motor Valves.

Representatives: Jimmy Dvoracek, sales manager; A. J. Hanssen, chief engineer; W. A. Oberholtzer, manager; C. O. Bloomfield, superintendent; R. G. Thompson, Paul E. Bowles, and T. F. Casey, Jr.

COLUMBIA STEEL CO.
Oklahoma Bldg., Booths 136-148

See listing under United States Steel Corp.

CONTINENTAL SUPPLY CO.
Blocks 6-7-8

127

COOK ELECTRIC CO.
Kansas Bldg., Booth 17

Will Exhibit: General line of "Magnilastic" expansion joints.

New: The "Pressurlator"—a new pressure regulating control for use in the liquefied petroleum gas industry.

Representative: R. T. Mathias, midwestern sales manager.

128

C. LEE COOK MFG. CO.
Texas Bldg., Booths 51-52

Will Exhibit: Metallic rod packing, graphitic iron piston rings.

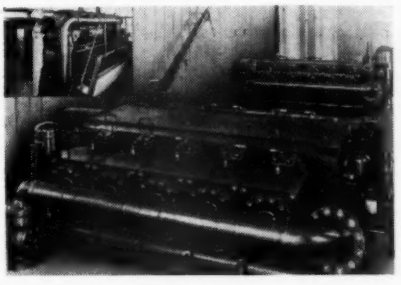
Representatives: W. Woobank, T. F. Hudgins, F. Black, W. Mayo, C. J. Kremer, and Robert E. Kirn.

129

COOPER-BESSEMER CORP.
Cooper-Bessemer Bldg., Block G

Will Exhibit: Gas-diesel compressors and liquid pumps in operation.

New: Type GMW, 10-cylinder, gas-diesel, 2 cycle, angle compressor, said to be the largest of its type in the world. It has an 18-in. bore by 20-in. stroke, and is rated at 240 hp./cyl. at 250 rpm. Type GMX Compressor, equipped with horizontal compressor cylinders with V-type power cylinders in the same vertical plane. Rated at 50 hp./cyl. at 400 rpm. Twin-Line, 6-cylinder Liquid Pump for handling a variety of liquids up to 64,000 b/d. and up to 2000 psi. pressure; applicable to lean oil pumping in absorption plants, hot and cold oil charging in refineries, and high-pressure boiler feeding.



Cooper-Bessemer's Twin-Line, 6-cylinder Pump

130

C-O-TWO FIRE EQUIPMENT CO.
Oklahoma Bldg., Booth 39

Will Exhibit: Carbon dioxide fire extinguishing equipment; pressure-operated systems using cylinders, wheeled one and two-cylinder portables, hand portables featuring the "Squeez-Grip" valve, and smoke detection systems.

New: Continuous showing of a technicolor motion picture, "Fire and Ice," which demonstrates the complete line of fire-fighting equipment in use.

131

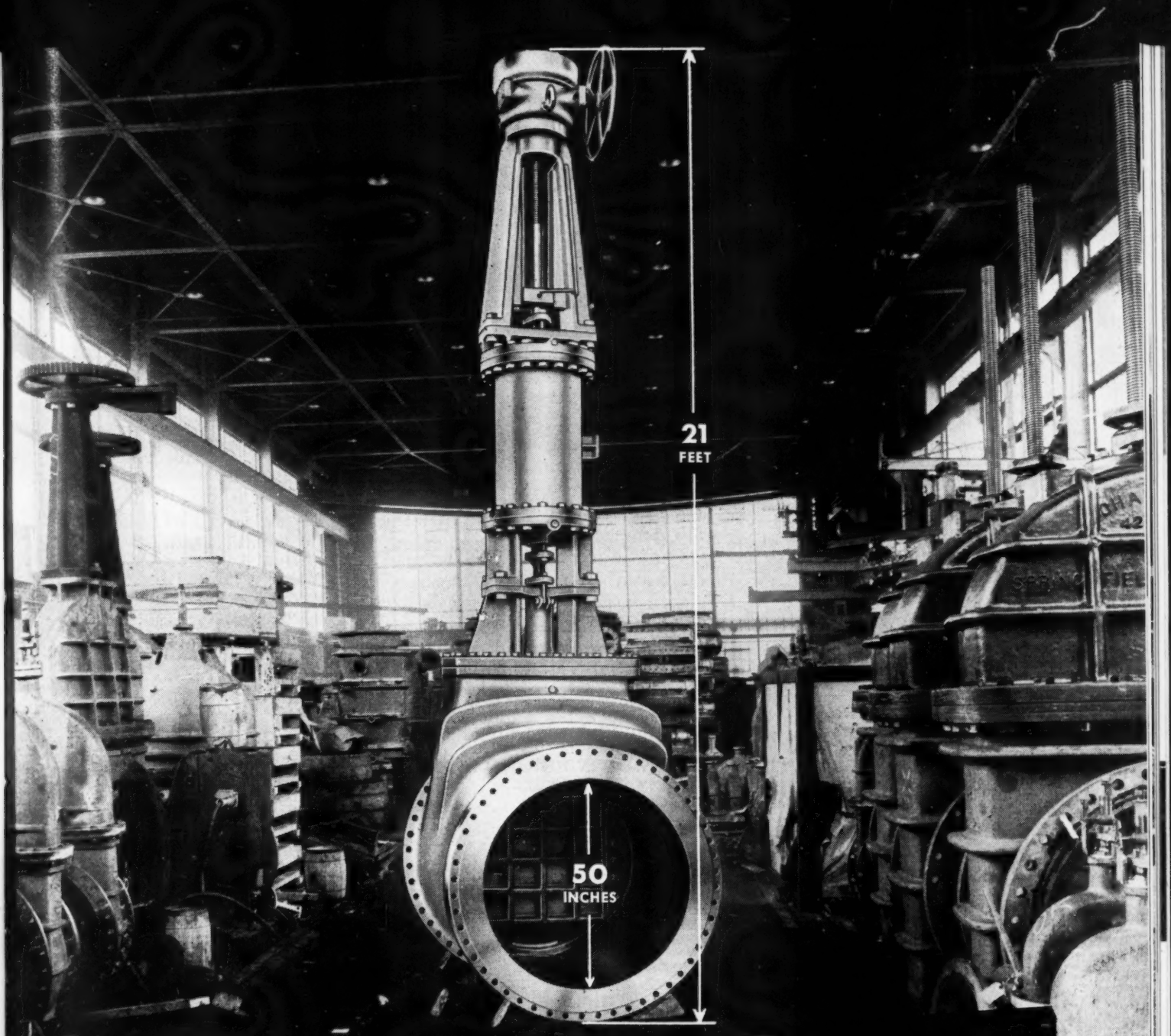
JOSEPH A. COY CO., INC.
Scientific & Technical Bldg.
Booths 63-64

Will Exhibit: "Coynco Stratube" atmospheric cooling sections; "Coynco Powairfin" air-cooled extended surface exchangers.

New: "Powairfin" units and a new bulletin on "Stratube" sections.

Representatives: Joseph A. Coy, president; Hugh R. Lamberth, sales manager; A. D. Payne and V. B. Scott.

For more information on these items, use reply card opposite p. 496.



At the Oil Show

A CHAPMAN STEEL SLIDE VALVE

Booths 24, 25, 26 Texas Building

for FLUID CATALYTIC CRACKING PLANTS

These Chapman "Specials" for refinery use were designed by the Standard Oil Development Company and Chapman engineers for service on fluid catalytic cracking lines. Approximately 2500 tons per hour of catalyst flow through the largest valves at a temperature of nearly 1200° F.

The valves are usually installed in a vertical line. The design is such as to prevent the packing and building up of the catalyst above and below the disc and to guide the flow so as to prevent excessive erosion. The body encloses an underslung disc seating on the bottom of a liner, thus preventing the catalyst from interfering with the seating. Operation is by special oil cylinder for full opening and closing of the valve, though in operation the port opening is continually varying in area due to the amount of catalyst required as determined by regulating instruments.

Chapman steel slide valves are made in a wide range of sizes from 3″ inlet with 1″ port weighing about 200 lbs. up to 50″ inlet and 28″ port weighing approximately 27,000 lbs. Operation is usually by oil cylinder with auxiliary hand operation, although valves of the smaller size are frequently only hand operated.

THE CHAPMAN VALVE MFG. CO.

INDIAN ORCHARD, MASSACHUSETTS

AMBASSADORS OF GOOD WILL

"Thanks for a very satisfactory job"

"Accept our extreme appreciation for the hearty cooperation your crews extended"

"I commend your erection crews for their ability, cooperation and general helpfulness"

AMBASSADORS

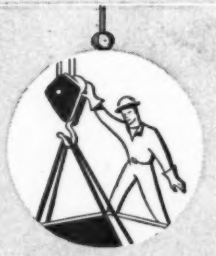
"...we are reminded of the American 'tank gang' who were in our midst for so many months and who left last week for Saigon. These 'tank gangers' have done something; they have perhaps done more to establish good-will in the Far East than all other American contacts, diplomatic or commercial. They have, in truth, proved themselves worthy ambassadors of the great nation to which they belong". J. E. K.

Above comment entitled "Ambassadors" appeared in the South China Morning Post, November 16, 1947, after the HAMMOND IRON WORKS crew left for Saigon.

"Yours is a very efficient organization"

"We look forward to using your crews on future projects"

"We must congratulate you on the efficiency and cooperative spirit of your crews"



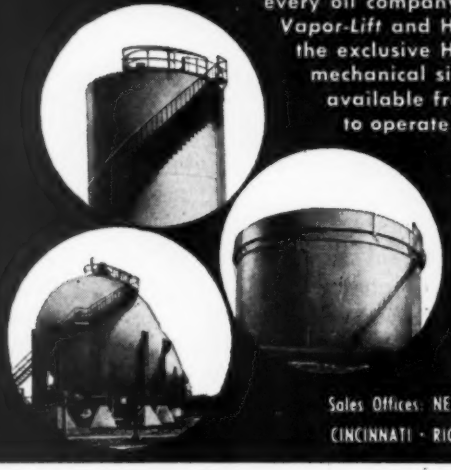
CUSTOMER SATISFACTION—THEIR POLICY

HAMMOND tank builders are Ambassadors of Good Will and service is their motto. Their every act, on and off the job, is guided by the spirit of helpfulness and customer satisfaction. Throughout the world they have left the impress of this spirit . . . in Hong Kong, Florida, Venezuela, Labrador, Panama, Texas, Shanghai, New York and wherever storage tanks are erected by Hammond.

Here is unsolicited testimony to the Good Will Hammond construction crews build into every completed job . . . the character and tank building abilities of Hammond erection crews bespeak the fine record of performance for the tanks they construct.

HAMMOND crews are constructing and rehabilitating storage tanks throughout the U.S.A. and many foreign countries.

HAMMOND CONSERVATION TANKS . . . *Vapor-Lift* and *Globe Roof* . . . are finding high favor for their conservation features. With prices for petroleum products on the increase and shortages becoming more prevalent, it behooves every oil company to investigate the Conservation Features of Hammond *Vapor-Lift* and Hammond *Globe Roof* Pressure Tanks. *Vapor-Lift* denotes the exclusive Hammond design of a lifter type roof, featuring extreme mechanical simplicity, and is available only from Hammond . . . also available from HAMMOND are specially designed Globe Roof Tanks to operate under pressures to 15 pounds per square inch.



HAMMOND IRON WORKS

WARREN PENNA. AND PORT NECHES TEX.

Sales Offices: NEW YORK · HOUSTON · BOSTON · PITTSBURGH · AKRON · DETROIT · CLEVELAND
CINCINNATI · RICHMOND · CHICAGO · PORTLAND, ME · SAN JUAN, P. R. · TIPSA, BUENOS AIRES

132

CRANE CO.
Oklahoma Bldg.,
Booths 196-197, 254-255

Will Exhibit: Valves for the petroleum industry; 600 psi. cast and forged steel valves; 6-in. iron valves; 6-in. pressure-seal-bonnet valve in cross section; and a large pipe coil to demonstrate the company's piping fabrication facilities. Two motor-operated valves will be on display—a 6-in., air-motor-operated valve for 900 psi. service, and a 6-in., electric-motor-operated valve for 600 psi. service. Both will be connected to a remote control panel enabling visitors to operate them.

Representatives: F. J. Wilkey, R. A. Hendrickson, Eric R. Seabloom, A. H. Hahn, R. O. Brendel, R. G. Hunter, and Vernon Kornhaus.

CROSBY STEAM GAGE & VALVE CO.
Scientific & Technical Bldg.
Booths 45-46, 57-58

CYCLONE FENCE DIVISION, AMERICAN STEEL & WIRE CO.
Oklahoma Bldg., Booths 136-148

See listing under United States Steel Corp.

133

DARLING VALVE & MFG. CO.
Oklahoma Bldg., Booths 113-114

Will Exhibit: Cast steel gate valves, iron body gate valves, bronze and special alloy gate valves, check valves, motor-operated gate valves, and fire hydrants.

New: Catalog 17M on Darling Valve Products.

Representatives: H. B. Foster, gen'l sales manager; C. H. Simon, chief engineer; M. L. Hough, president; D. F. Sable, R. F. Heath, F. W. Hammett, L. A. Hoffmeister, C. L. Hartman.

DAVIS REGULATOR CO.
Scientific & Technical Bldg.
Booths 45-46, 57-58

134

DEARBORN CHEMICAL CO.
Texas Bldg., Booths 106-107

Will Exhibit: Protective coatings;

For more information on these items, use reply card opposite p. 496.

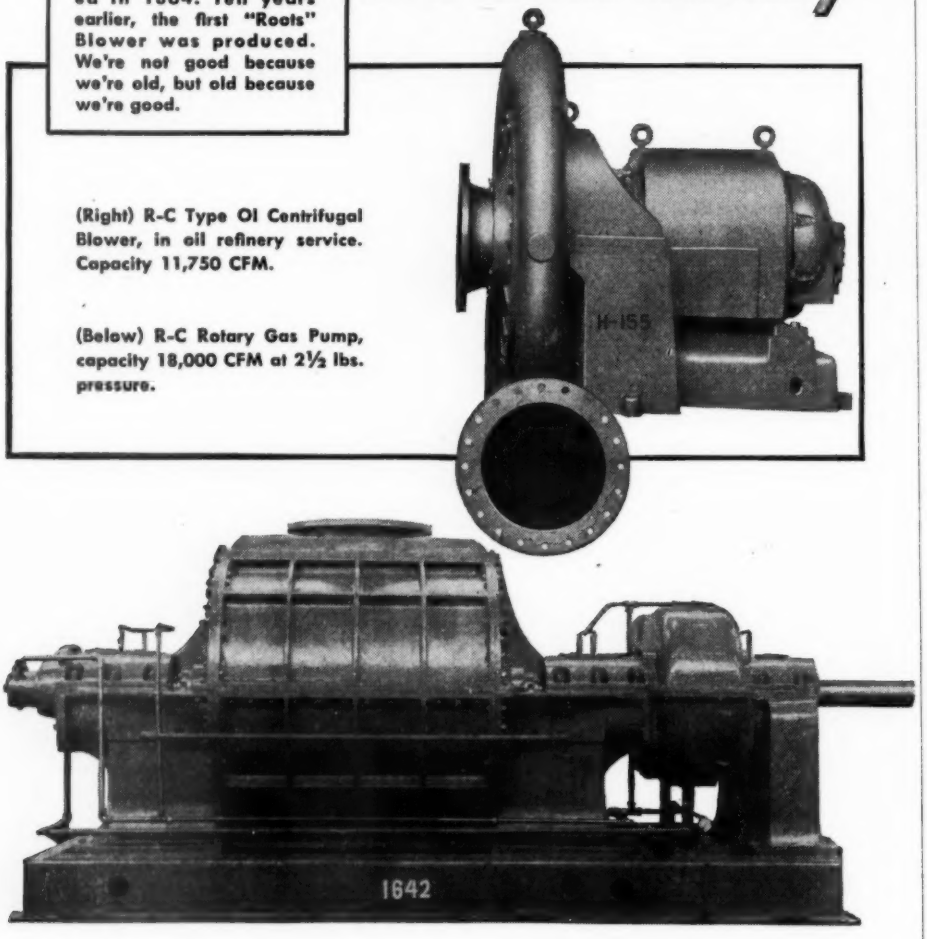
New expansion fittings
save space, piping, and
installation costs
SIDE "T"
LATERAL "L"
FOOT "L"
REDUCING "T"
MagniLastic is first again with a new concept in simplified piping installation. Anchor base expansion joint fittings solve many plant layout problems involving limited space and movement due to changes in temperature and pressure.
As illustrated, a wide variety of combinations are possible, each complete with anchor base ready for bolting to floor, wall, or ceiling girder. Bellows are selected from standard MagniLastic catalog series to accommodate temperature, pressure and corrosive conditions. Number of diaphragms is variable to handle expansions encountered. Flanged or weld ends are optional.
MagniLastic expansion fittings are compact, simple to install, save time, and permit economies in space, maintenance and cost of other fittings. Our engineering department will be glad to recommend the right combination for your needs.
Complete MagniLastic Expansion Joint catalog No. 254 on request
SEE OUR EXHIBIT AT THE I.P.E. SHOW IN TULSA, MAY 15 - 22.
MAGNILASTIC
Division of COOK ELECTRIC COMPANY, Chicago 14
"THERE IS A MAGNILASTIC EXPANSION JOINT FOR EVERY PIPING NEED"

The Solvay soda process was commercially perfected in 1864. Ten years earlier, the first "Roots" Blower was produced. We're not good because we're old, but old because we're good.

Exclusive Service... R-C dual-ability

(Right) R-C Type OI Centrifugal Blower, in oil refinery service. Capacity 11,750 CFM.

(Below) R-C Rotary Gas Pump, capacity 18,000 CFM at 2½ lbs. pressure.



You obtain an important, exclusive advantage when you consult us about problems of moving air or gas. That is, our *dual-ability* to supply either Centrifugal or Rotary Positive units.

This *dual choice* allows you to match equipment exactly to your needs, in capacities, pressures and other characteristics. You can have standard Rotary Positive units from 10 CFM up to 50,000 CFM, or Centrifugal units from 2,000 CFM up to 100,000 CFM.

So, utilize this exclusive *dual-ability* by consulting us on all your blower and gas pump requirements. The economy and dependability of R-C Blowers have been proved for almost a century.

ROOTS-CONNERSVILLE BLOWER CORPORATION
805 Texas Avenue, Connersville, Indiana

ROOTS-CONNERSVILLE ROTARY CENTRIFUGAL
BLOWER BUILDERS R-C SINCE 1854
BLOWERS · EXHAUSTERS · BOOSTERS · LIQUID AND VACUUM PUMPS · METERS · INERT GAS GENERATORS

★ ★ ONE OF THE DRESSER INDUSTRIES ★ ★

rust preventives; pipe line coatings and wrappers; water softening chemicals and testing equipment.

New: Protective wrap for lead sheathed cables; woven asbestos tape.

Representatives: E. M. Converse, vice-president; C. B. Smith, T. L. Holcombe, P. B. Payne, Ted Kennedy, R. W. Kelly, J. M. Haltom.

135

DOWELL, INC.
Block L, on Drake Drive
Opposite the Cafe de Petrol

Will Exhibit: An industrial chemical service for removing scale from refining and all types of heat exchange equipment.

Representatives: The company will have about 50 men from 23 states as hosts at their display.

DRESSER INDUSTRIES, INC.
Block 11

E. I. DU PONT DE NEMOURS & CO.
Texas Bldg., Booths 93-100, 111-115

136

DURAMETALLIC CORP.
Texas Bldg., Booth 14

Will Exhibit: "Durametallic" packings; "Duraseal" rotary mechanical seal; and packing tools.

New: "Duraseal" Type PS, a single, non-lubricated mechanical seal for holding hydrocarbons in the presence of high pressures.

Representatives: Roscoe R. Smith, sales manager; R. D. Hall, general manager; W. D. Emery, L. J. Gregory, Allison Walker, and Dale Fontaine.

137

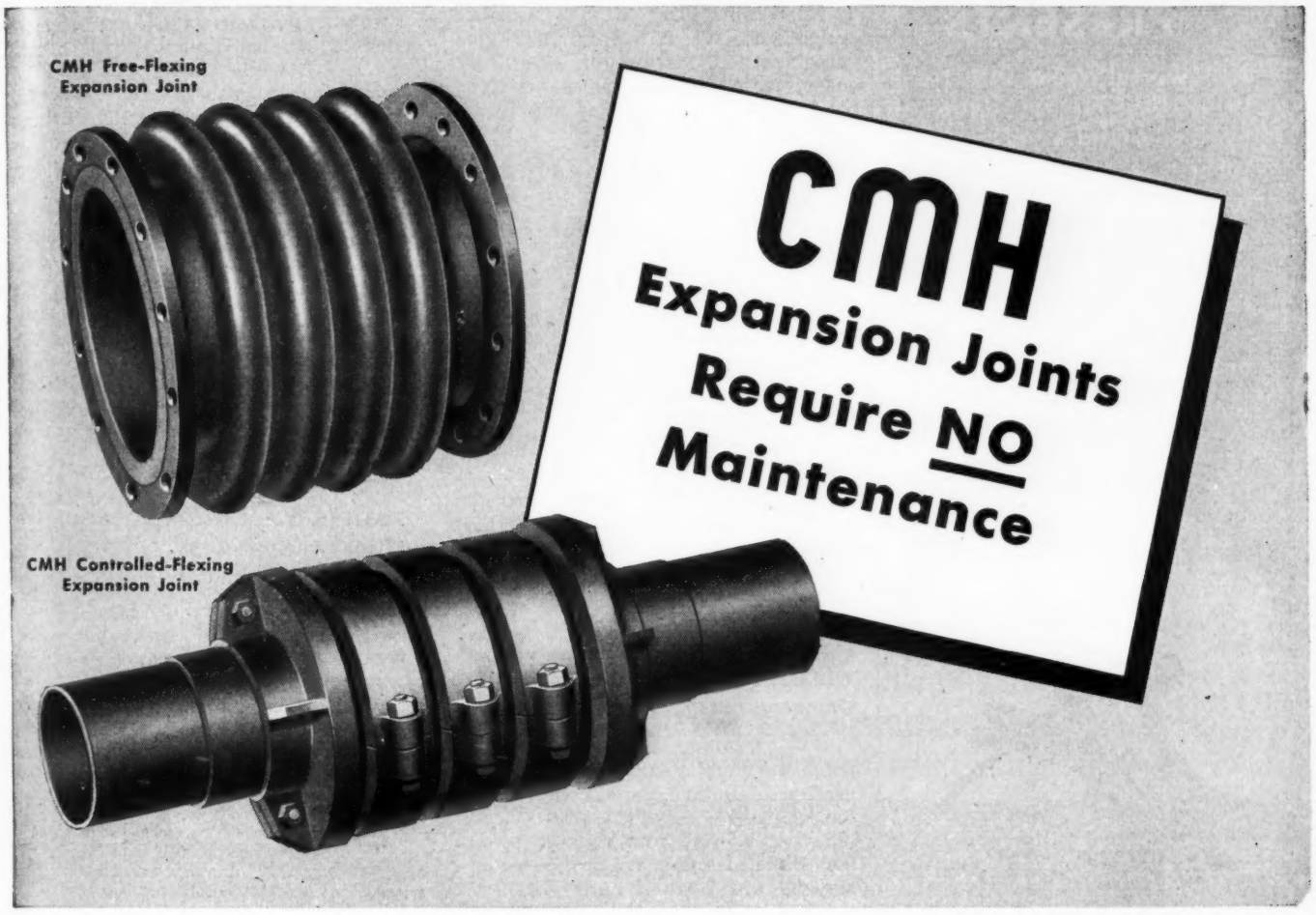
EDWARD VALVES, INC.
Scientific & Technical Bldg.
Booths 33-38

Will Exhibit: Forged and cast steel stop, check, gate, non-return, hydraulic, gage, blow-off, Intex, welded bonnet Univalve, and relief valves; strainers; and packing.

New: Intex and Univalve integral seat valves, 7500 psi. hydraulic valves, pressure-seat bonnet non-return valves, gage and gate valves, and gas field check valves. The Uni-

For more information on these items, use reply card opposite p. 496.

Here is the CMH answer to expansion joint maintenance problems



CMH Controlled-Flexing Expansion Joints
Sizes 4" to 24" Inside Diameters. For Pressures up to 300 p.s.i. Temperatures to 900° F. Copper or Stainless Steel Pressure Carriers. Traverse from 5/16" to 6-3/4". Flanged or Welding ends. Control Rings Corrugation-mated to close working tolerances.

CMH Free-Flexing Expansion Joints
Sizes 4" to 24" Inside Diameters. For Pressures up to 30 p.s.i. Temperatures to 900°F. Copper or Stainless Steel Pressure Carriers. Flanged or Welding Ends.

Once a CMH Expansion Joint is installed you can forget about it. *There are no maintenance problems . . . there is no maintenance expense.* CMH Expansion Joints are FLEXONICALLY* engineered to give years of dependable service in the control of expansion and the correction of piping misalignment. They are compact units requiring a minimum of space.

CMH Engineered Applications take the guesswork out of expansion joint selection . . . your best assurance of getting the right expansion joint for the job. Write today, for complete details and ask for a copy of Expansion Joint Bulletin EJ-47.

"FLEXON" identifies CMH products, which have served industry for more than 45 years.

*the science of FLEXONICS . . . "the controlled bending of thin metals for use under varying conditions of temperature, pressure, vibration and corrosion" . . . is exemplified in the basic products of Chicago Metal Hose Corporation.

CMH EXPANSION JOINTS

CHICAGO METAL HOSE CORPORATION
Expansion Joint Division • Maywood, Illinois
Plants at Maywood, Elgin and Rock Falls, Illinois

Airetool

PRESENTS

A Powerful, New Direct Drive Cleaner for Heat Exchanger and Condenser Tubes.

Write today for details about this powerful cleaner that weighs only 21 lbs. For cleaning straight tubes ⅜" to 1½" I.D. . . . with or without supporting rig!

Bulletin No. 40 available

No. CC-450

PLAN TO VISIT

Booth 41 Kansas Bldg.

Airetool's Display during the 1948 International Petroleum Exposition Tulsa, Okla.

See the latest designs of tube cleaners, tube expanders and Oil Refinery specialties developed for the oil refinery industry.

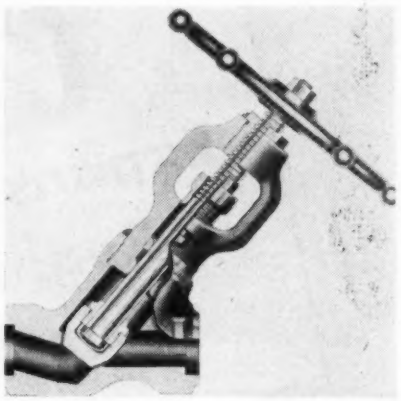
AIRETOOL

MANUFACTURING COMPANY

SPRINGFIELD, OHIO

valve has a welded bonnet and integral seat, is forged chromium-molybdenum steel, and recommended for services to 1500 and 2500 psi. steam pressure at 1000 F.

Representatives: W. F. Crawford, president; W. A. Marsteller, vice-president; D. MacGregor, chief engineer; R. A. Durand, sales manager; and D. O. Bayless, sales engineer.



Edward's "Intex Univalve"

138

ELLIOTT CO.
Oklahoma Bldg., Booths 125-126

Will Exhibit: "YR" mechanical drive turbine, steam-driven, for operation of pumps, fans, compressors, etc. Capacity ranges to 2000 hp., exhaust pressures from vacuum to 250 psi. Tube cleaners, featuring a long-surface, swing-frame cutter head, for tube I. D.'s from 2-1/4 to 8 in.

Representatives: F. W. Dohring, vice-president, sales; W. E. Widau, J. N. McClure, and J. M. Maag.

139

ENGINEERING LABORATORIES, INC.
Scientific & Technical Bldg. Booths 22 and 78

New: "Penetron" Gamma ray inspection tool for testing wall thicknesses from one side only; "Gagetron" Gamma ray liquid level recorder and controller which measures and controls level from outside the vessel.

Representatives: E. B. Jones, vice-president and sales manager; W. M. Wells, ass't sales manager; F. R. Wheeler, J. F. Caywood, M. D. Carter, and S. O. Snyder.

140

FAIRBANKS CO.
California Bldg., Booths 50-51

Will Exhibit: Bronze and iron body valves; steel-framed hand and platform trucks; special drum handling equipment.

New: A line of 200 psi. union bonnet bronze gate valves fitted with integral and renewable seat rings; a line of 300 psi. union bonnet bronze globe and angle valves with two different types of stainless steel plug type discs and seats, 500 Brinnel hardness.

Representatives: R. G. Macbeth, C. L. Haslup, L. Compton, K. M. McClean, J. J. Langan, and R. W. Draughon.

FAIRBANKS MORSE & CO.
Kansas Bldg. Booth 37
California Bldg., Booths 10-13

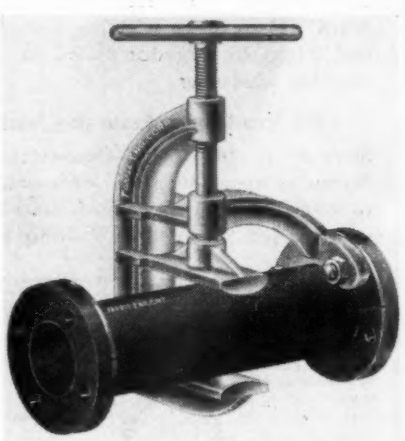
141

FARRIS ENGINEERING CORP.
Silver Lane, Booth 32

Will Exhibit: "Farriseal" corrosion relief valve; heat exchanger (steam coil) relief valve; 10,000 psi. compact, semi-nozzle barstock relief valve.

New: Nozzle safety valve, 8 x 10 in., said to be world's largest; New "Pinch Valve", hand operated or automatically controlled, for control of flow of highly abrasive and corrosive materials. Similar in operation to familiar laboratory pinch cock. Valve is made of rubber-and-cloth composition tubing, semi-steel frame, and stem is Type 416 Stainless steel. Available in sizes from 1 to 10 in., for working pressures up to 100 psi.; other sizes from 12 to 96 in.

Representatives: V. W. Farris, president, in charge of booth.

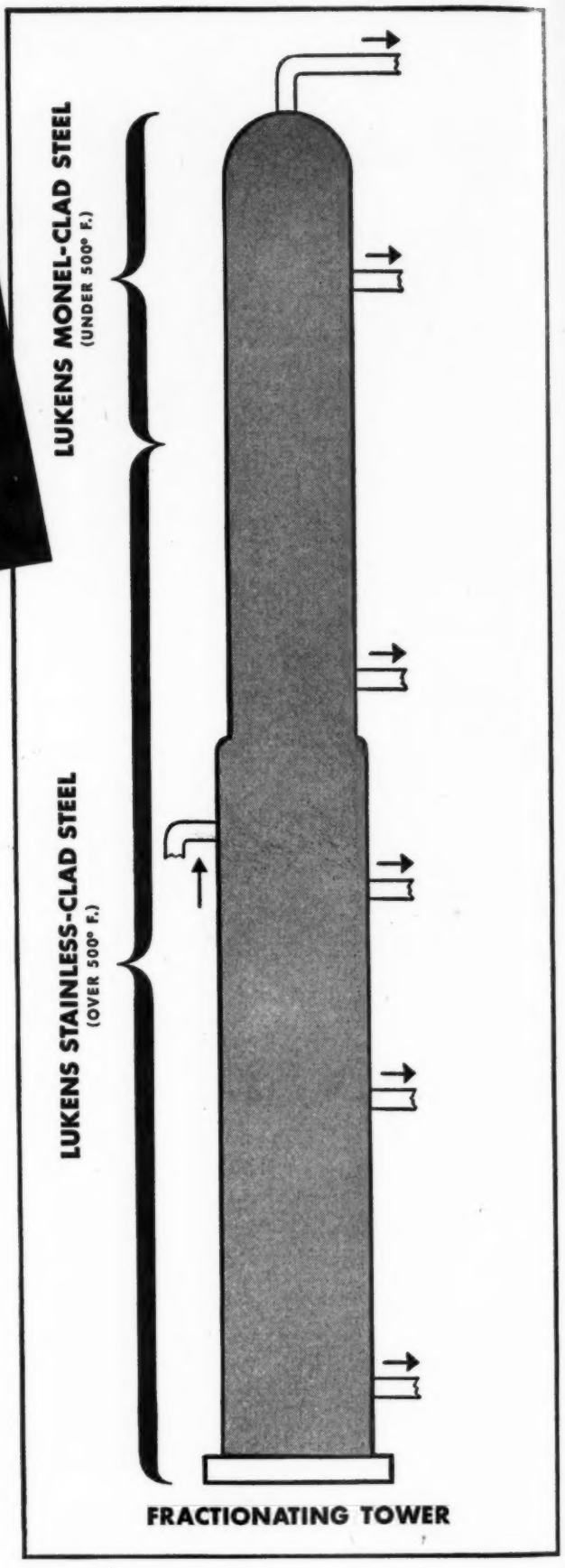


Farris Engineering's Pinch Valve

For more information on these items, use reply card opposite p. 496.

Experience:
OUR ANSWER TO YOUR PROCESSING PROBLEMS . . .
During its 18 years of continuous service to the natural gasoline and refining industries, Petroleum Engineering, Inc., has designed and constructed more than 200 gas processing plants.
Our experience was enriched with each new job as we developed and applied new and advanced engineering practices.
The same trained technicians who have successfully solved more than 200 other processing problems are available for consultation with you.
PETROLEUM ENGINEERING, INC.
Houston • Tulsa
Visit us at Booth 222, Oklahoma Building
Photographed for Petroleum Engineering, Inc.
By Robert Yarnall Richie

Combat Corrosion in Fractionating Towers with two Lukens Clad Steels



"Practically standard now for corrosion-resistant construction", says a petroleum engineer about this division of corrosion-resisting responsibility between two Lukens Clad Steels. Stainless-Clad in the lower section withstands the attack of crudes that are high in sulfur. Monel-Clad successfully resists the acids that form at the top, and is applicable for temperatures under 500°F.

Teamwork between Lukens Clad Steels—the most complete range available—is common throughout the Petro-Chemical Industry. You'll find Lukens Stainless-Clad Steel going into one piece of refinery equipment and Inconel-Clad, Monel-Clad or Nickel-Clad into others right alongside. Each has its "best" applications, a rating determined by long experience.

Each Lukens Clad Steel is a precision product from assembly to finish, consisting of a uniform thickness of the corrosion-resisting metal permanently bonded to an ASME quality backing plate. Plate sizes run up to 178″ wide, or $\frac{3}{16}$″ to over 3″ thick, with cladding in percentage of total plate thickness to suit your requirements.

You can get assistance in choosing Lukens Clad Steels by contacting Lukens. Bulletins 255 and 338 contain helpful data. Lukens Steel Company, 443 Lukens Building, Coatesville, Pa.

LUKENS
Nickel-Clad Stainless-Clad
Inconel-Clad Monel-Clad
STEELS

Visit our booth at the International Petroleum Exposition at Tulsa, Oklahoma, May 15-22

SOLID METAL ADVANTAGES WITH CLAD STEEL ECONOMY

• • SPEED SCRAP TO THE MILLS TO MAKE MORE STEEL • •

142

FISCHER & PORTER CO.
Scientific & Technical Bldg.
Booth 25

Will Exhibit: "Flowrator" variable-area meters for measurement and control of flow rates; specific gravity recorders; "Ratosleeve" meters for large pipe and large flow rates, which can be installed inside ordinary pipe fittings; armored "Flowrators" for high-pressure service; "Ratotronic" electronically-operated remote indicators for rates as low as 5 ml./min.; "Viscorator" continuous viscosimeter; and automatic flow ratio controllers.

New: Pneumatic or gas-driven flow rate totalizer.

Representatives: W. A. Diament, vice-president & sales manager; H. F. Lorence, advertising manager; D. J. Condit, divisional field manager, Tulsa; R. W. Fritzsche, divisional field manager, Houston.

143

FISHER GOVERNOR CO.
Texas Bldg., Booths 78-79

Will Exhibit: "Wizard" Pilot-Operated Regulators, "Level-trols," "Gismo" Micro-flow Control Valve.

New: "Positrol" Valve Positioner, and new Type 67 Combination Reducing Valve and Filter Set.

Representatives: P. A. Elfers, vice-president and sales manager; R. A. Engle, vice-president and chief engineer; G. F. Brockett, ass't. chief engineer; T. B. Burris, ass't sales manager; L. E. Eiger, ass't sales manager; and A. E. Ehrke, sales engineer.

144

FLINT STEEL CORP.
Scientific & Technical Bldg.
Booths 20-21

Will Exhibit: Bank of multitubular heat exchangers.

Representatives: C. M. Cooper, C. F. Mooney, D. E. Fields, H. G. Lewis, S. L. Spence, H. A. Hofflander.

145

FLUOR CORP.
Scientific & Technical Bldg.
Booths 47-48

Will Exhibit: Fluor Pulsation Dampeners, used to reduce excessive vibrations in discharge lines from reciprocating type compressors due to pulsating gas flow. Fluor Dampeners have been used extensively in refineries, gas and cycling plants to reduce possible damage from vibration and to decrease required pipe sizes.

New: Bulletins; 1) "Pulsation Phenomena in Gas Compression Systems," 2) "Fluor Pulsation Dampener," 3) "High Purity Natural Gas by the Glycol-Amine Process," 4) "Fluor 'Counterflo' Cooling Tower Catalog," 5) "Evaluating Cooling Towers," 6) "Fluor Products Catalog."

Representatives: J. R. Fluor, vice-president & ass't. gen'l manager; J. P. Wiseman, vice-president & director of sales; G. H. Dieter, ass't. sales manager; M. A. Ellsworth, C. F. Royse, C. E. Gregg, C. E. Pickup, D. H. White, and C. Yates.

FOOTE BROS. GEAR & MACHINE CORP.
Block G

FORMICA INSULATION CO.
Silver Lane, Booth 14

See listing under Plastelite Engineering Co.,

146

FOXBORO CO.
Scientific & Technical Bldg.
Booths 18-19, and 65

Will Exhibit: A large flow sheet of a modern refinery will highlight control instrument applications; the Model 40 Controller; Dynalog all-electronic instruments, including the thermocouple and resistance bulb types.

New: Model 41 Controller for ordinary temperature and pressure applications; the "D/P Cell" (differential pressure), particularly designed for corrosive service, or where a meter with small displacement is required, or the use of mercury is undesirable.

Representatives: C. E. Sullivan, vice-president and gen'l sales manager; V. V. Tivy, sales manager, refining industry; L. K. Spink, engineer in charge of flow measurement; D. H. Fuller, sales manager, electronic instruments; D. H. Fuller, J. J. Burnett, W. A. Melton, F. D. Brindel, E. L. Stark, R. H. Hemfelt, J. E. Hendricks, L. W. Parten, E. E. Kleir, W. A. Rock, J. B. Deaderick, E. R. Huckman, and J. J. Connelly.

FRANCE PACKING CO.
Texas Bldg., Booth 72

147

GARLOCK PACKING CO.
Texas Bldg., Booths 59-60

Will Exhibit: Complete line of mechanical packing for pumps, valves, etc., used in petroleum industry.

Representatives: George L. Abbott, president, Phil Arnold, vice-president; H. J. Kuhn, district manager.

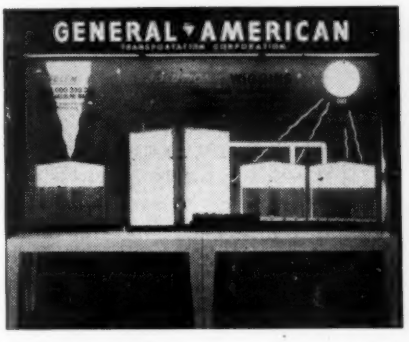
148

GENERAL AMERICAN TRANSPORTATION CORP.
Oklahoma Bldg., Booths 5-6

Will Exhibit: Wiggins conservation structures—the Floating roof, and the Dry Seal lifter roof.

New: An animated display demonstrating the operation of the Wiggins Dry Seal Gas-Holder in conserving losses from a battery of interconnected petroleum storage tanks.

Representatives: H. D. Skyrm, gen'l sales manager; J. F. Olsen, ass't sales manager; J. C. Thompson, ass't chief engineer; F. W. Horner, E. D. Rollins, and J. D. Camp.

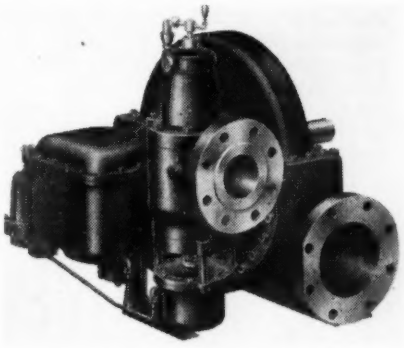


General American's working model of the Wiggins Dry Seal Gas Holder

149

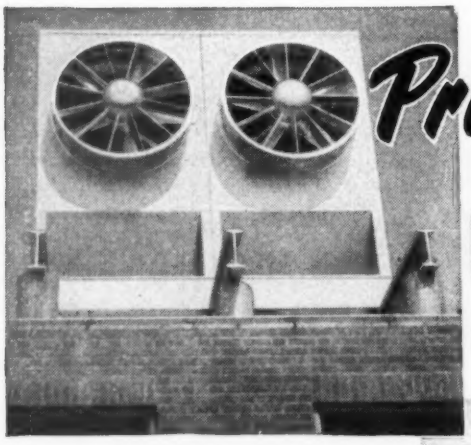
GENERAL ELECTRIC CO.
Oklahoma Bldg., Booths 241-244

Will Exhibit: Mechanical drive turbines, electronic motor control center, starters, control devices, portable



General Electric's Type DP turbine

For more information on these items, use reply card opposite p. 496.

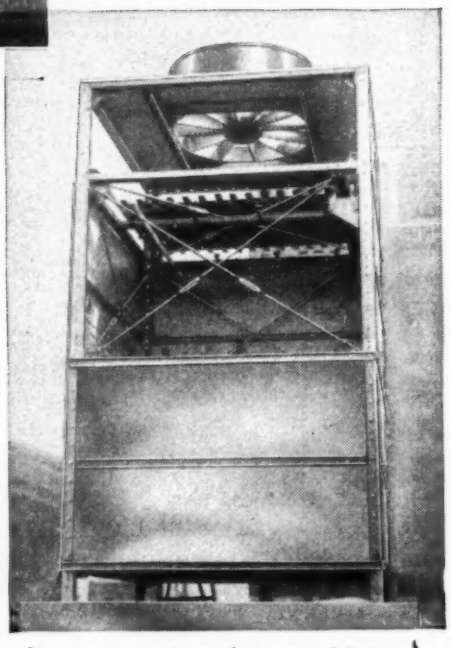


Pritchard

Small and Medium Capacity

COOLING TOWERS

Shipped from Stock!



INDUCED DRAFT either horizontal or vertical air flow, with the outstandingly efficient Moore "Lifetime" Fans

. . . the All-Monel fan with permanently lubricated direct drive motor built right into the hub

These All-Monel Fans provide the first fully satisfactory solution to operating difficulties which have vexed owners of mechanical draft cooling towers for years.

No gears, no belts, no coupling, no corrosion problems. Maintenance is nil! These ruggedly constructed, cooling tower, pressure blowers are service-proved for trouble-free, high-efficiency, heavy-duty performance under severest operating conditions.

The slow-speed, ball bearing motor is cased in the hub and suspended in the fan ring by hollow vanes. These vanes guide the air stream and also permit fresh air to enter to ventilate the lifelong lubricated motor.

Other advanced and thoroughly proven Pritchard mechanical and structural features throughout the tower.

Also NATURAL DRAFT TOWERS . . .

available in a complete range of capacities for roof or ground installation as standard spray towers, or with coil systems in base for closed system cooling. Offered with or without basins or internal decks. Low pressure water distribution system minimizes pumping cost. Slip-fit louvers lift out easily for access to interior. Simple bolted assembly of Redwood or All-Metal shipped complete, knocked down. No special knowledge, special tools or skilled labor required to install.

Also all other types and sizes; 20 years of Cooling Tower Leadership.

For further information see Sweet's Files, Chemical Engineering Catalog, ASH & VE Guide, etc., or phone or write your nearest Pritchard office.

J.F. Pritchard & Co.

ENGINEERS • CONSTRUCTORS • MANUFACTURERS

for the CHEMICAL, PETROLEUM, GAS & POWER industries

welding equipment, cable, motors, electro-hydraulic governing system for DC motors.

New: Small mechanical drive turbine, Type DP, with ratings from 10 to 1200 hp. and speeds from 1000 to 5000 rpm, available in three single-stage frame sizes with a 16, 20, and 25 in. wheel. Orders filed now will bring delivery within 15 weeks.

Representatives: C. A. Falkenau, and members of sales engineering department.

GERRARD STEEL STRAPPING CO.
Oklahoma Bldg., Booths 136-148

See listing under United States Steel Corp.

GRAVER TANK & MFG. CO.
Kansas Bldg. Booth 77

GROVE REGULATOR CO.
Texas Bldg., Booths 36-37

150

D. W. HAERING & CO., INC.
Kansas Bldg., Booths 127-128

Will Exhibit: Organic glucosates used in the petroleum industry to control scale, corrosion, and algae in cooling systems, boilers, compressors, and other water-using equipment.

151

HAMMEL-DAHL CO.
Scientific & Technical Bldg.
Booths 45-46, 57-58

Will Exhibit: Diaphragm control valves with spline and reduced area plugs, with split-lap flange construction, in cast iron, cast steel, stainless steel; gas regulator valves; and "Venturiflo" angle valves.

New: Type 7505 "Microflo" Control Valve with solid Stellite spline plug, in Type 316 Stainless body; used for pilot plant work or minute flows at high pressure drops. Bulletin 100 describes this valve.

Representatives: E. T. Dahl, president; Bruce A. Irwin, vice-president; J. R. Curran, chief engineer; Otto Kneisel, development engineer.

For more information on these items, use reply card opposite p. 496.

HAERING
ORGANIC
GLUCOSATES
control
SCALE
CORROSION
ALGAE
in the
PETROLEUM
INDUSTRY
Visit our exhibit at booths
127 and 128
Kansas Building
International
Petroleum
Exposition
Tulsa, Okla. May 15-22
WRITE US FOR
TICKETS
H-O-H
WE READ
WATER
D. W. HAERING & CO., Inc.
GENERAL OFFICES:
205 West Wacker Drive, Chicago 6, Illinois

152

HAPPY CO.
Block J

Will Exhibit: Young-Happy Standard and Master Series coolers, used to cool engine jacket water, lubricating oil, gas, and to condense steam. Also for process cooling and condensing, still overhead product, absorption oil cooling, and distillate condensing. Y-H Coolers are widely used on portable compressor units.

New: VAD-16 cooling unit—vertical air draft with 16 ft. diameter fan, cores on two sides, fan at top, right angle gear reducer to drive fan. "Vortox" LB Air cleaners; LB-50 size on display—50 in. diameter, 8000 cfm. capacity.

Representatives: Paul E. Mahaffey, president; Leo C. King, vice-president and sales manager; Roy C. Lindley, sec'y-treasurer; W. H. Gorey, W. T. Swearingen, F. W. Robson, J. R. Meek, Orville L. Smith, Jack Simpson, Ed Allan, Jimmie Allen, Bus Williams, Cotton Rundle, Ben Shelton, Charley Kitch, Bill McCracken, and John Ritter.

HARNISCHFEGER CORP.
Kansas Bldg., Booths 32-35

HOBART BROS.
Kansas Bldg., Booths 10-16

HYATT BEARING DIV. GENERAL MOTORS CORP.
Block 10

153

HYSTER CO.
Park Lane, Booths 26-28

Will Exhibit: Mechanical material handling equipment useful in refinery maintenance, warehousing, and handling of products.

New: Model "20" Lift Truck, a 2000 lb. capacity fork lift truck for drums and piece goods; Model "40", a 4000 lb. capacity fork lift truck equipped with a crane, boom, and fork for odd-shaped or awkward loads; "Karry Krane", a 10,000 lb. capacity, pneumatic-tired, mobile crane for yard handling of valves, pressure vessels, manifold assemblies, and the like.

Representatives: C. H. Collier, Jr., Clarence Houston.

154

INGERSOLL-RAND CO.
Block J

Will Exhibit: Compressors, refinery and pipe line pumps, turbo-blowers, portable compressors and air tools.

New: A new gas engine-driven compressor.

Representatives: H. N. Fiske, J. Janzen, K. Har, W. R. Bell, L. H. Geyer, W. Lee, F. Wetzel, F. Sultan, and A. Holland.

155

INTERNATIONAL NICKEL CO.
Texas Bldg., Booths 64-65

Will Exhibit: The company is not a manufacturer of equipment but supplies large amounts of nickel alloys to the petroleum industry. No equipment will be displayed but the background of the booth will be devoted to a flow sheet of the oil industry showing the uses of nickel alloys.

JARECKI MFG. CO.
Texas Bldg., Booths 87-88

JERGUSON GAGE & VALVE CO.
Scientific & Technical Bldg.
Booth 86

156

JOHNS-MANVILLE CO.
Oklahoma Bldg., Booths 44-47

Will Exhibit: Insulation, refractories, packings, Transite asbestos-cement pipe, asbestos pipe-line felts.

New: A new packing, Johns-Manville 71S.

Representatives: L. A. Baldwin, W. P. Gibbons, F. W. Hodson, T. C. Greenwood, H. E. Mayfield, E. B. Yost, M. C. Parmley, O. J. Moore, J. W. Orr, C. T. Norman, M. E. Duncan, and E. J. Liggett.

157

JOHNSTON & JENNINGS CO.
Oklahoma Bldg., Booths 82 and 129

Will Exhibit: Tank fittings; conservation vent valves; internal tank valves, flame arrestors; pressure and vacuum valves.

Representatives: William H. McGunagle, sales manager; and C. J. Van Landeghem, vice-president.

158

JONES & LAUGHLIN STEEL CORP.
Jones & Laughlin Bldg., Block 1

Will Exhibit: Tubular products, pipe and tubing; wire rope products; steel barrels, oil drums, grease drums, and chemical drums.

Representatives: T. E. Crawford, for the J & L Steel Barrel Co.

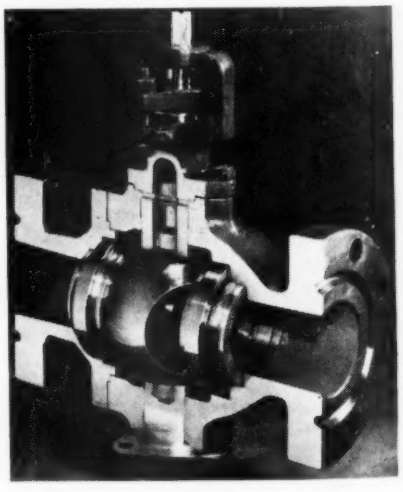
JUSTRITE MFG. CO
Scientific & Technical Bldg.
Booth 17

159

KEROTEST MFG. CO.
Oklahoma Bldg., Booths 89-90, 121-122

Will Exhibit: Full flow pipe line gate valves, redesigned lubricated flow line valves, and stainless steel valves, in all standard sizes from 500 to 5000 psi. working pressure, and dimensioned in accordance with API Standards No. 5-6-2. Gate valves are double disc or solid wedge construction, single or double handwheel, gear or motor-operated, in sizes from 2 to 24 in., OS & Y, or NRS.

New: The "Kerosphere" ball-type plug valve, in which the initial mechanical load of seat against ball remains constant regardless of line pressures. Sizes are from 2 to 4 in., capacities from 500 to 2000 psi., up to 450° F. maximum temperature.



Kerotest's new ball-type plug valve, the "Kerosphere"

KEUFFEL & ESSER CO.
Oklahoma Bldg., Booth 213

For more information on these items, use reply card opposite p. 496.

160

KIELEY AND MUELLER, INC.
Kansas Bldg., Booths 81-82

Will Exhibit: "Kontrol-Motor" diaphragm valves pressure regulators, liquid level controls, "Kontrol-Master" pressure pilots. Valve body assemblies are available for pressures up to 6000 psi. The pressure pilot is available in ranges from 15 to 10,000 psi.

Representatives: Joseph O'Connor, president; C. B. Ives, chief engineer; R. J. Donnelley and S. L. Stentz.

161

KOPPERS CO., INC.
Texas Bldg., Booths 73-75

Will Exhibit: Industrial piston rings, "Fast's" self-aligning couplings; pressure treated wood for marine piling and structural timber; "Bituplastic" protective coating for metal surfaces that will not "alligator."

Representative: John Worthington, sales manager, Piston Ring Division.

Ladish Co.'s Seamless Reducing Elbow

162

LADISH CO.
Kansas Bldg., Booths 7-9

Will Exhibit: Seamless welding pipe fittings; forged steel flanges, screwed and socket welding fittings; drop forgings. Fittings displayed will also be in carbon, stainless, and alloy steels.

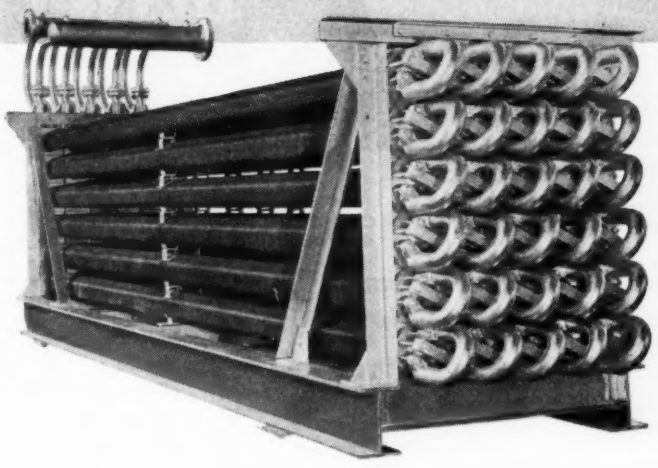
New: Seamless Reducing Elbow, designed for the elimination of both an elbow and a reducer; a 20 in. taper designed full branch outlet tee; new 112-page Seamless Welding Fittings Catalog.

Representatives: J. F. Hacker and R. M. Foltz, vice-presidents; W. F. Gardner and W. O. Kupper, ass't sales managers; H. L. Pehrson, J. D. Best, G. E. Mahoney, R. C. Foltz, and M. S. Kachigan.

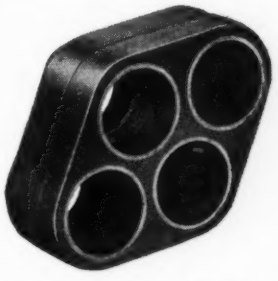
For more information on these items, use reply card opposite p. 496.

Slow to foul - easy to clean

G-R TUBEFLO SECTION



Dirty or sediment-carrying fluids are constant sources of trouble and service expense when heated or cooled in conventional designs of heat transfer apparatus.
However, here is a heat exchanger that has proven its superiorities for more than fifteen years and in 4000 installed units, handling cracking coil residuum, crude oil, fluxed asphalt, clay-bearing oil, and on similar duties.



- ONE TUBE PER PASS . . .
- CONTINUOUS HIGH VELOCITY . . .
- NO POCKETS . . .
- NO INTERLEAKAGE BETWEEN FLUIDS . . .

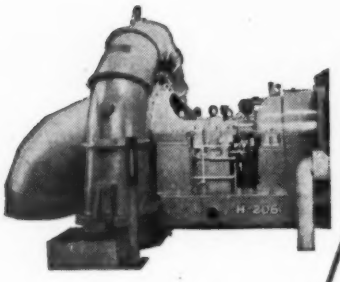
In the G-R Tubeflo Section, all passages, including return bends, are of uniform area, so that continuous high velocity of the fluids carries tar or sediment completely through the unit. In many instances these units are maintaining initial capacity indefinitely on services which had previously necessitated shut-down and cleaning of shell-and-tube units before the end of a single run. When shut-downs for cleaning are necessary, the large-diameter tubes minimize cleaning time and effort.
But greater freedom from clogging and greater ease of cleaning are only two of the many advantages of the G-R Tubeflo Section. For complete information on these units, write for our Bulletin 1621.

THE GRISCOM - RUSSELL CO.
285 Madison Avenue, New York 17, N. Y.

GRISCOM-RUSSELL
Pioneers in Heat Transfer Apparatus

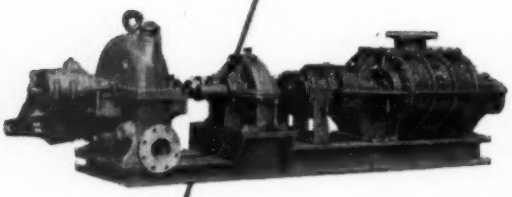
All our transfer equipment contains more types

THAN YOUR NEW REFINERY CAN NEED



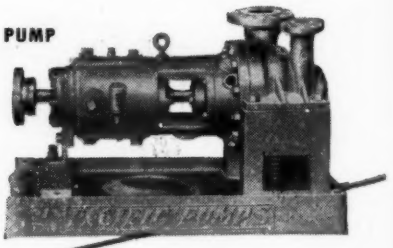
● ROOTS-CONNERSVILLE—CENTRIFUGAL EXHAUSTER

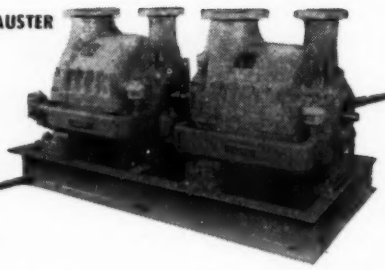
Couplings	Dresser Mfg. Division
Centrifugal Compressors	Clark
Centrifugal Pumps	Pacific
Rotary Positive Blowers	Roots-Connersville
Reciprocating Gas Compressors	Clark
Storage Tanks	Stacey Bros.
Engines—Gas or Oil	Clark
Exhausters	Roots-Connersville
Inert Gas Generators	Roots-Connersville



● ROOTS-CONNERSVILLE—ROTARY POSITIVE EXHAUSTER

● PACIFIC—CENTRIFUGAL PUMP





● CLARK—CENTRIFUGAL COMPRESSOR

Variations to fit your need, that's the keynote of Dresser Industries approach to refinery equipment. And to pipe line and well equipment, too.

Not all pumping in a refinery calls for horizontals, nor all for centrifugals. Not all refinery gas need be moved by compressors. On the other hand, sometimes even the biggest rotary positive blower proves less efficient than a small compressor.

The sales engineers of Dresser Industries can afford to give you unbiased advice at these variable points. Because a sale stays in the Dresser family whether it goes to Clark Bros. compressors or to Roots-Connersville blowers; to Pacific Pumps centrifugals or to Clark centrifugals.

Equipment to fit the problem, from Dresser Industries; not a sale to fit the equipment.

DRESSER INDUSTRIES, INC.

TERMINAL TOWER • CLEVELAND 13, OHIO

Matched Equipment Matchless Service

BOVAIRD & SEYFANG Mfg. Co.
Bradford, Pa.

BRYANT Heater Company
Cleveland, Ohio; Tyler, Texas

CLARK Bros. Co., Inc.
Olean, New York

DAY & NIGHT Mfg. Co.
Monrovia, Calif.

DRESSER Mfg. Division
Bradford, Pa.

DRESSER Mfg. Company, Limited
Toronto, Ont., Canada

INTERNATIONAL Derrick & Equipment Co.
Beaumont & Dallas, Texas; Torrance, Calif.; Columbus, Marietta & Delaware, Ohio

KOBE, Inc.
Huntington Park, Calif.

PACIFIC Pumps, Inc.
Huntington Park, Calif.

PAYNE Furnace Co.
Beverly Hills, Calif.

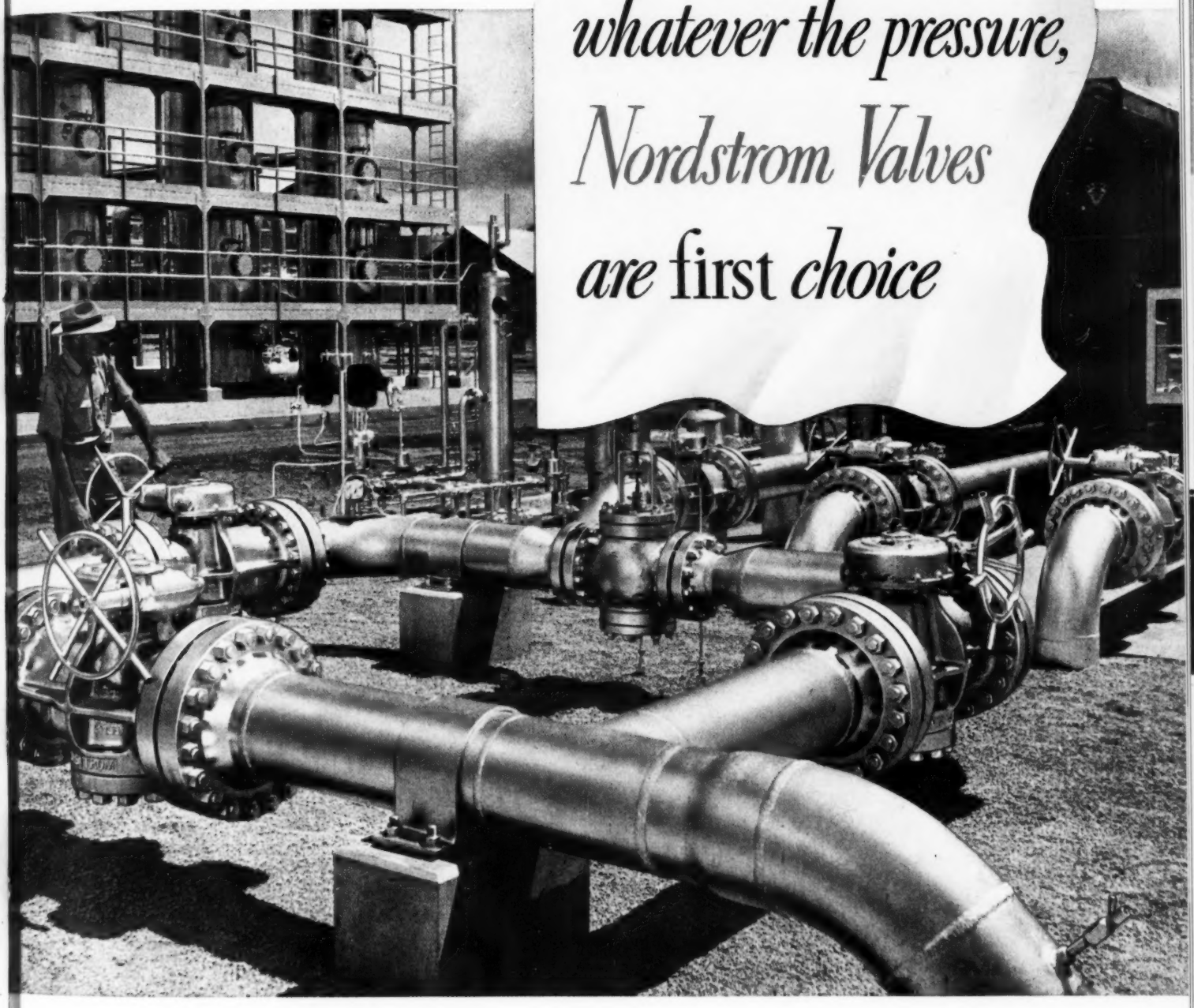
ROOTS-CONNERSVILLE Blower Corp.
Connersville, Ind.

SECURITY Engineering Co., Inc.
Whittier, Calif.

STACEY BROS. Gas Construction Company
Cincinnati, Ohio

Stacey-Dresser Engineering Division
Cleveland, Ohio

Wherever you go, whatever the pressure, Nordstrom Valves are first *choice*

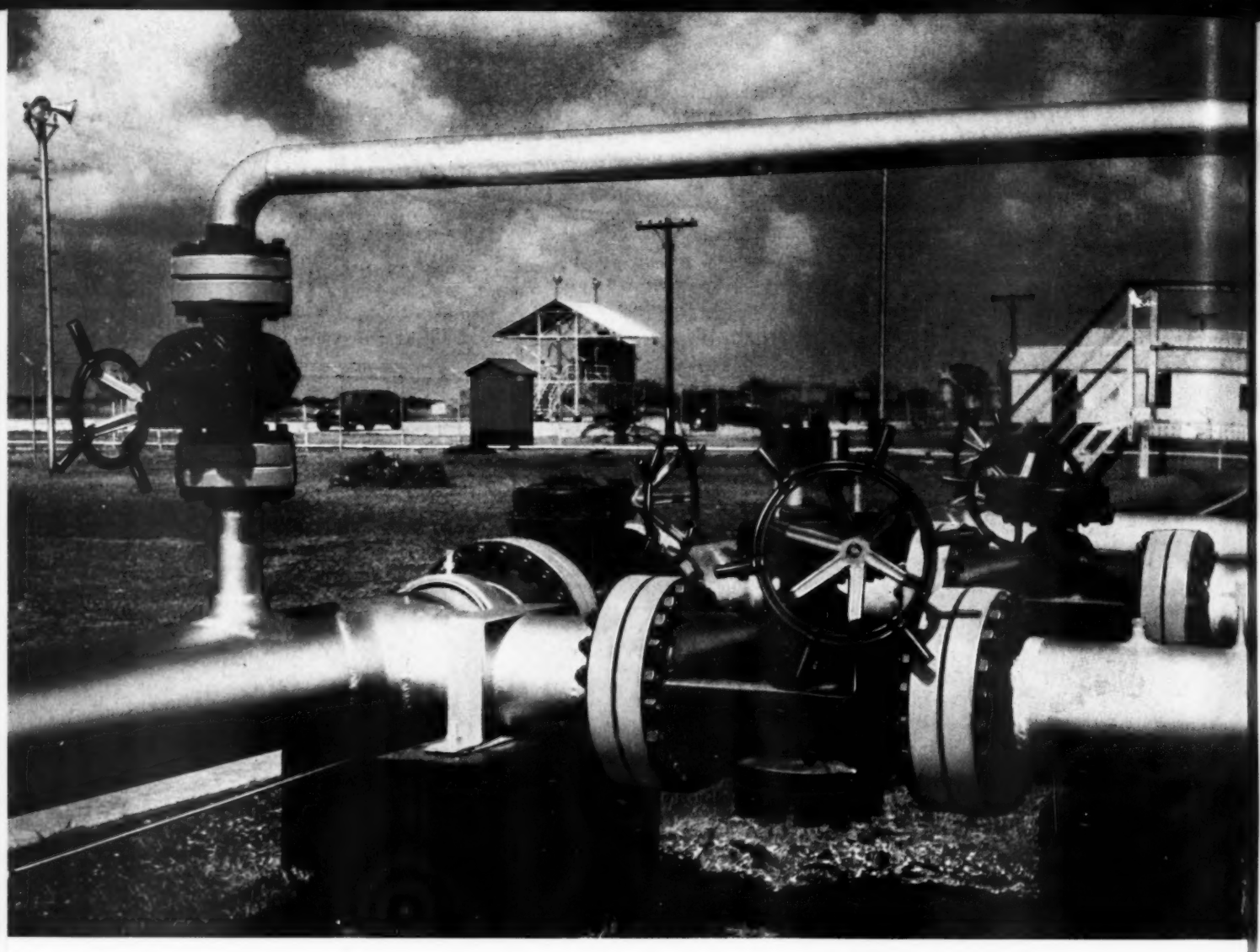


Elimination of valve failures alone more than justifies the cost of Nordstrom lubricated plug valves—but the economy of increased valve life, assurance of leakproof service and convenience of operation are additional bonuses you get when you install Nordstroms. *It pays to use* ***genuine*** *Nordcoseal lubricants.*

Nordstrom LUBRICATED VALVES

ROCKWELL

KEEP UPKEEP DOWN

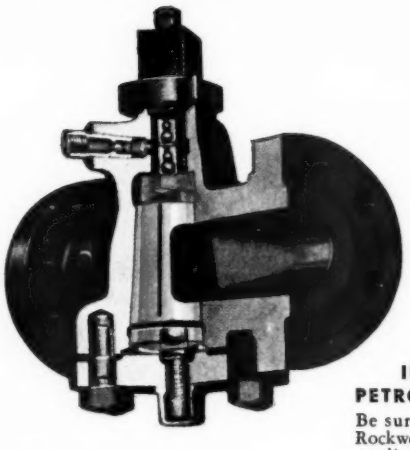


Nordstrom valves give you control at all pressures *without distortion*

Unlike the conventional types of valves which must be seated by *distortion*, and in which the vital seating surfaces are exposed in the open position to the deteriorating influences of the line fluid, Nordstrom valves operate on the rotary principle.

In Nordstrom valves, pressure lubrication surrounds the plug with a protective and sealing lubricant film, assuring operation and prolonging valve life. Lubrication is essential in any moving mechanism where thrust is applied, to prevent friction, wear and corrosion.

Nordstrom simplicity and compactness are advantageous in installation, operation and maintenance. "Sealdport" lubrication has proven its merit in hundreds of thousands of installations in the petroleum, gas and chemical industries.



HYPRESEAL for severe conditions

The Nordstrom Hypreseal valve has made an outstanding record in services involving high pressures, elevated temperatures, abrasion, etc. Triple sealed, it can be repacked under pressure and in any position.

INTERNATIONAL PETROLEUM EXPOSITION

Be sure to see the products of Rockwell Manufacturing Company on display in the Scientific and Technical Building, booths 33-38.

Nordstrom LUBRICATED VALVES

ROCKWELL

Sealdport Lubrication

NORDSTROM VALVE DIVISION – *Rockwell Manufacturing Company*

WORLD'S LARGEST MANUFACTURERS OF LUBRICATED PLUG VALVES

***Main Offices:* 400 North Lexington Ave., Pittsburgh 8, Pa.**

Atlanta • Boston • Chicago • Houston • Kansas City • Los Angeles • New York • Pittsburgh • San Francisco • Seattle • Tulsa • and leading Supply Houses

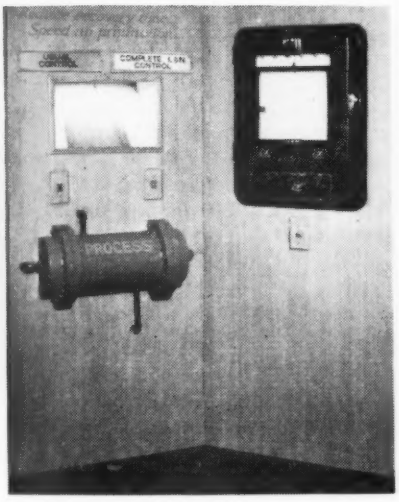
Export: Rockwell International Corporation, 7701 Empire State Bldg., New York 1, N.Y.

163

LEEDS & NORTHRUP CO.
Scientific & Technical Bldg.
Booths 29-30

Will Exhibit: Instruments in operation; Speedomax Pneumatic Controller; multiple-point temperature recorders; Speedomax for extra-fast recording and Micromax for all other applications; Speedomax high-speed indicator for logging a large number of temperatures in rapid succession; L&N Portable Indicators for pH and temperature.

New: Working model heat exchanger with the new L&N Pneumatic Controller demonstrating smooth operation without cycling or overshoot.



Leeds & Northrup's Pneumatic Controller in operation

164

LINCOLN ELECTRIC CO.
Oklahoma Bldg.,
Booths 249-250, 201-202

Will Exhibit: Lightweight gasoline engine-driven welder for field repairing; the "Manual Lincolnweld" hidden arc process for welding pipe joints and flanges.

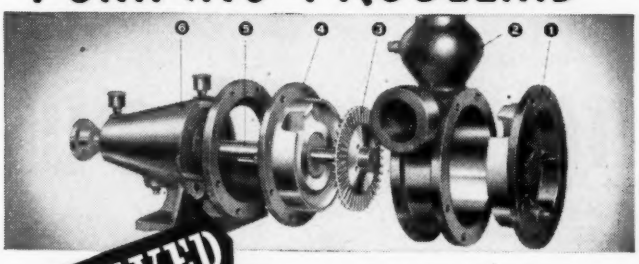
New: Demonstrations of new hard facing electrodes "Tungweld" and "Faceweld", and "Shield-Arc LH-70" electrode for welding hardenable steels.

Representatives: A. F. Davis, vice-president; J. R. Morrill, R. L. Looney, and E. B. Reeves.

LUDLOW VALVE MFG. CO., INC.
Block 3

For more information on these items, use reply card opposite p. 496.

PUMPING PROBLEMS*



SOLVED IN ROTH PUMPS!

Look at these features:

1. Outboard head—easily removed.
2. Case—can be rotated to various positions.
3. Impeller—self adjusting, no seizing at high temperatures.
4. Inboard head — only one packing box.
5. Stainless steel shaft.
6. Heavy cast iron frame.

Stainless steel heads, impeller, and case available.

- Flexible coupled and close coupled pumps in stock.
- Motors up to 25 HP in stock.

Write for catalogs 1 & 2.

***Whatever your pumping problem, consult Roth. Experienced engineers will recommend the equipment you need—will design special pumps for unusual applications.**

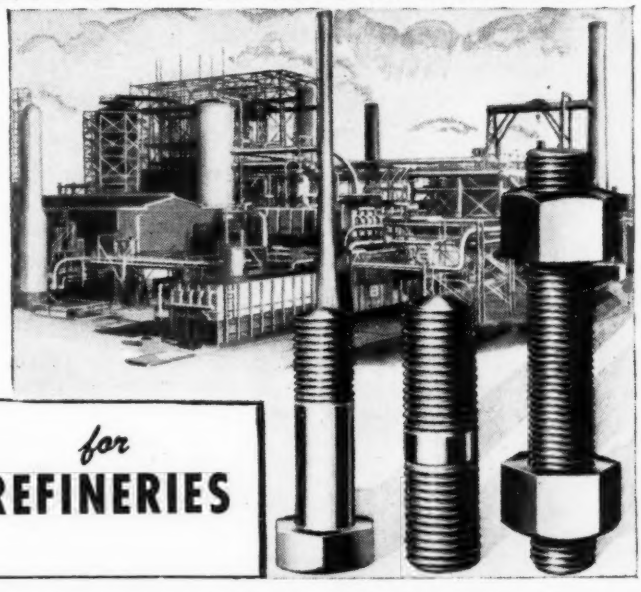
Speeds up to 3600 RPM
Capacities up to 200 GPM
Pressures up to 175 lbs.
Viscosities up to 500 SSU

ROY E. ROTH COMPANY • 2426 Fourth Avenue • Rock Island, Illinois

ROTH PUMPS

ERIE SPECIAL BOLTING FOR HEAVY MACHINERY

FOR over 30 years ERIE has specialized in the manufacture of *high quality bolting*. We use the very latest equipment for heat treating, machining, grinding and threading. We are certain that we can produce better bolting at a saving to you because we are specialists — send us your bolting specification for our estimate.



for REFINERIES

A DEPENDABLE SOURCE OF HIGH QUALITY BOLTING FOR RAILROADS, REFINERIES, DIESELS, FARM MACHINERY, EXCAVATING EQUIPMENT AND ALL TYPES OF HEAVY MACHINERY.

ERIE BOLT & NUT CO.
SUBSIDIARY OF BARIUM STEEL CORPORATION
ERIE, PA.
STUDS • BOLTS • NUTS ~ ~ ALLOYS • STAINLESS • CARBON • BRONZE

BUY....

CALITE HEAT ENDURING CASTINGS

to

DEFINITE CHEMICAL AND PHYSICAL SPECIFICATIONS

This Will Assure Uniform Quality and Service

STANDARD SPECIFICATION NO. 10-38

Heat Enduring Castings
For Industrial Furnace Construction
Grade "F"

CHEMICAL COMPOSITION:

(a) The castings shall conform to the following requirements as to chemical composition:

	GRADE "F"
Chromium, per cent	25.0-28.0
Nickel, per cent	10.0-12.0
Manganese, per cent	0.50-1.25
Silicon, per cent	0.25-1.75
Sulphur, maximum per cent	0.05
Phosphorous, maximum per cent	0.05
Carbon	Within limits of Paragraph 4 (c)

(b) The chemical limits for all other added alloying elements, such as molybdenum, titanium and nitrogen, shall be specified by the manufacturer. The material shall conform therewith.

CREEP STRESS AND CERTIFICATE:

(a) The indicated creep rate of the material shall not exceed 1% in 10,000 hours when stressed by a tensile load not less than the following:

TEMP. °F.	STRESS PER SQ. IN. 1% CREEP IN 10,000 HOURS
1400°	4200#
1500°	3700#
1600°	3200#
1700°	2600#
1800°	1950#

(b) Manufacturer shall submit standard creep data and residual physical properties made on material of his own manufacture and certified by an ACCREDITED LABORATORY. The chemical analysis of the creep test specimens shall be reported, including nitrogen content and any other special alloying elements.

TENSION TEST FOR DUCTILITY AFTER HEATING:

(a) Each heat shall conform to the following requirements as to tensile properties after the specimen has been subjected to a temperature of 1400° F. for 24 hours and furnace cooled to 400° F. Test shall be made at room temperature.

	GRADE "F"
Tensile Strength, min.lb./sq.in.	80,000
Yield Strength, min.lb./sq.in.	35,000
Elongation in 2", min. per cent	9.0

Copy of complete specification will be mailed upon request

THE CALORIZING COMPANY

HEAT ENDURING AND CORROSION RESISTING METALS.
CALITE ALLOY CASTINGS — CALORIZED STEELS.

WILKINSBURG STATION **PITTSBURGH 21, PA.**

LUFKIN RULE CO.
Texas Bldg., Booths 121-122

165

LUKENS STEEL CO.
Oklahoma Bldg., Booth 195

Will Exhibit: Demonstrations, test specimens, and photographs to show the advantages of Lukens Clad Steels for the petroleum industry. These products—Nickel-Clad, Stainless-Clad, Inconel-Clad, and Monel-Clad—consist of a layer of the corrosion-resistant alloy permanently bonded to a heavy backing plate of ASME quality steel, the thickness of the clad varying between 10 and 20% of the total plate thickness depending on specific applications. A testing device will demonstrate the uniformity of cladding. The basic welding sequence for fabrication with clad steels will be illustrated with welded pieces. A flanged and dished head formed of Lukens Clad Steel will also be displayed.

Representatives: G. M. Gillen, William J. Powers, Franklin M. Beltrando, and Dr. Charles W. Rippie.

166

LUNKENHEIMER CO.
Oklahoma Bldg. Booths 67-68

Will Exhibit: Bronze, iron, steel, and corrosion-resistant valves; boiler mountings; air devices; lubricating devices; cocks; whistles.

New: 125 psi. S. P. bronze globe, angle, and check valves; 125, 150, and 200 psi. bronze gate valves; bronze globe and angle valves with 500 Brinell type stainless steel plug seats and discs.

Representatives: H. E. Lunken, vice-president and ass't. gen'l. manager; H. A. Burdorf, vice-president, sales; H. H. Layritz, ass't. sales manager; J. A. Birkhead, D. R. Davis, S. H. Hill, C. B. Rosser, Jr., M. N. Stickel, E. R. Tieberman, Jos. Waldeck, sales; F. H. Hehemann, chief engineer; and William Brinkman, engineering department.

167

MAGNUS CHEMICAL CO., INC.
Texas Bldg., Booth 46

Will Exhibit: Cleaning compounds used in both production and refining; Magnus "Aja-Dip" cleaning machines for cleaning dismantled and disassembled metal parts.

Representatives: W. E. O'Meilia, T. O'Brien, A. Eckhardt, W. A. Marp, and M. Zinty.

MANNING, MAXWELL & MOORE, INC.
Oklahoma Bldg., Booth 230

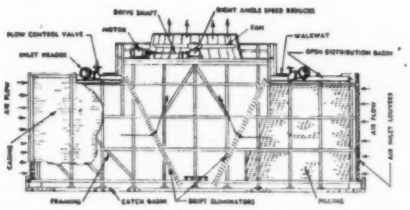
168

MARLEY CO., INC.
Kansas Bldg., Booth 78

Will Exhibit: Double-flow cooling towers.

New: Model of the Marley Double Flow horizontal induced draft cooling tower, and new descriptive bulletins.

Representatives: L. T. Mart, president; Ray T. Jenkins, vice-president; L. A. Christensen, sales manager; Roy W. Maze, director of public relations; Howard Degler, technical director; Joe McKinley, W. O. Kretzmier, E. T. Gessell, and Walter Smith.



Marley's Double Flow Cooling Tower

MAXIM SILENCER CO.
Blocks 6-7-8

McNAMAR BOILER & TANK CO.
Texas Drive, Booths 1-2

MERIAM INSTRUMENT CO.
Scientific & Technical Bldg.
Booth 27

169

MIDWEST PIPING & SUPPLY CO., INC.
Jones & Laughlin Bldg.

Will Exhibit: High pressure, high temperature, pre-fabricated piping assemblies; carbon steel and nickel bearing alloy welding fittings and flanges.

New: A line of stainless steel welding fittings.

Representatives: Eric A. Kerbey, exec. vice-president; S. T. Seeley, vice-president; and J. L. Jacobsen.

170

MILTON ROY CO.
Kansas Bldg., Booths 23-24

Will Exhibit: Chemical and high pressure positive displacement pumps used for handling hot or cold distillates, solvents, furfural, sweet or sour naphtha fractions, liquefied petroleum gases, tars and asphalts, petrolatum, acids and acid sludges. Applications include solvent extraction, inhibitor addition, controlled catalyst make-up, and other blending. Among units shown will be a pump with electronic speed control of discharge rate directly proportional to flow, temperature or any metered variable.

171

MINE SAFETY APPLIANCES CO.
Oklahoma Bldg., Booths 48-49

Will Exhibit: Benzol indicator; hydrogen sulfide detector; hose masks; tank gaugers' masks; "Skullgard" safety hats; "All-Weather" first aid kits; portable electric flood light; welding helmets; safety goggles; and safety belts.

New: Portable methane alarm; combustible gas analyzer with 8-way sampling valve; "Colorimetric" carbon monoxide tester using indicator tubes developed by the Bureau of Standards; "Chemox" self-contained, oxygen, breathing apparatus, designed especially for fire-fighting and short duration emergency use; it makes its own oxygen as the wearer breathes, and has a replaceable cannister.

Representatives: H. W. Richards; W. H. Gates; G. J. Gruber, J. W. Meehan, J. B. Davies, N. W. Hartz, and G. L. Seth.

172

MISSION MFG. CO.
Texas Bldg., Booths 91-93, 118-120

Will Exhibit: Centrifugal pumps; automatic lubricated plug valves; fluid end pistons and piston rods; "Self-Sealing" gland packings; and other oil industry equipment.

New: The centrifugal pumps incorporating the Scherzer hydraulic principle, which is said to provide streamlined flow from a concentric casing, for sustained efficiency, long life, and low maintenance cost under severe operating conditions. Available in the following sizes: 1 x 1½, 1½ x 2, 2 x 3, 3 x 4, 4 x 5, and 5 x 6; with capacities ranging up to 1200 gpm, heads up to 300 ft., and speeds up to 3500 rpm.; in cast iron, bronze, steel, 18-8 stainless, 30-10 stainless, Ni-Resist, and nickel.

Representatives: J. H. Barmister, C. V. Bell, Jr., W. F. Bennett, R. W. Chapman, C. W. Fryar, A. E. Higginbotham, F. S. Mims, J. H. Nolen, Jr., D. J. Ollre, A. R. Parker, L. I. Roberson, L. M. Roberson, O. E. Ryan, C. L. Turner, J. E. Young, M. C. Davis, Cecil Cardinal, Jeff Tucker, and C. R. Summers.

For more information on these items, use reply card opposite p. 496.

"...here's MY Headquarters!"

s in the Field—so at the Show: Make
e JONES & LAUGHLIN BUILDING
our headquarters.

t this great Silver Anniversary of the
ternational Petroleum Exposition learn
ore about why Jones & Laughlin Sup-
ly service is reliable — resourceful —
iendly. Meet representatives of our
anufacturers as well as our own men.
ee our exhibits and take time out to
st and chat here with friends from the
orld's oil fields.

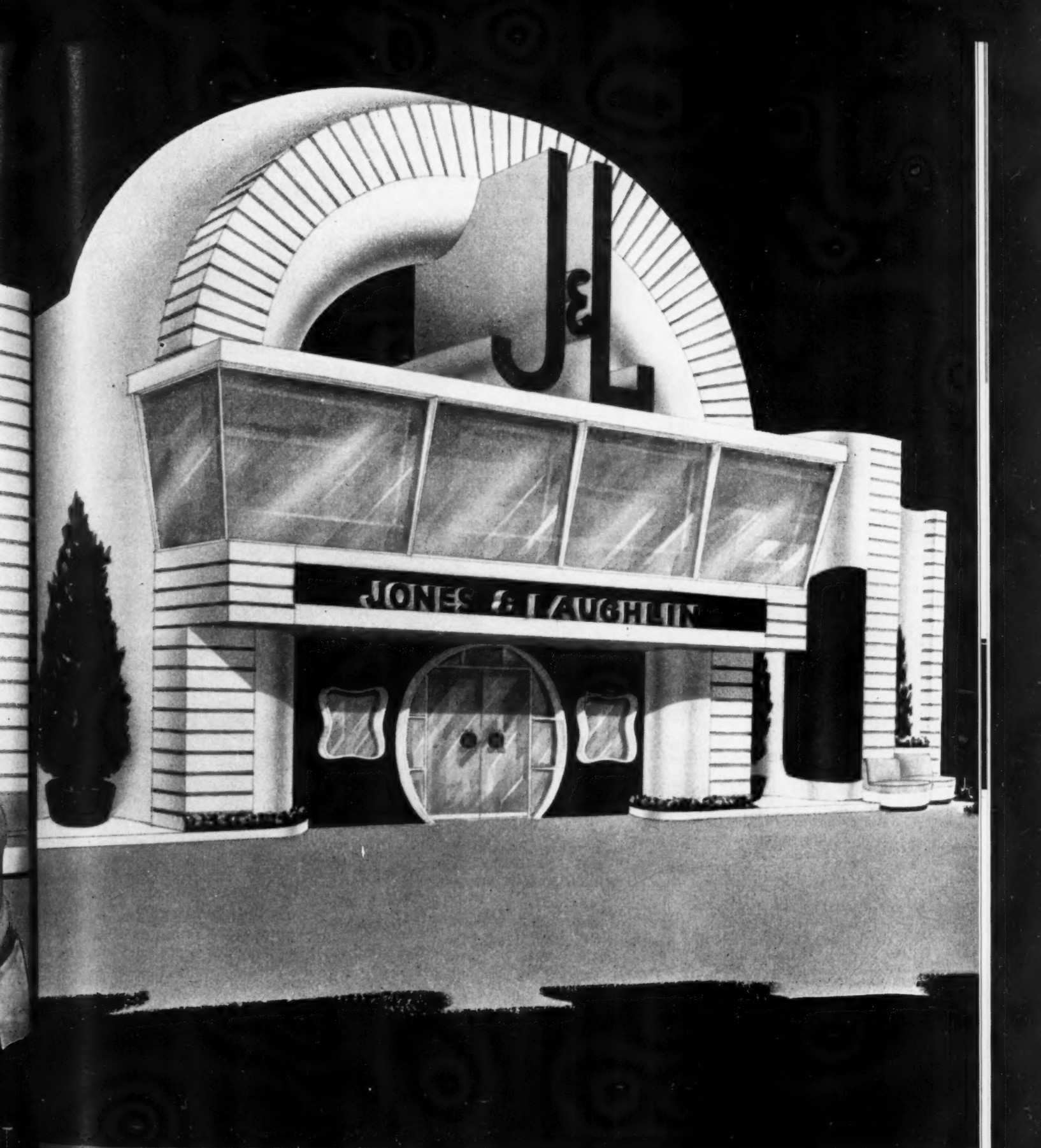
ur whole effort has been to make our
khibits interesting—instructive and to
fford a place where the oil man can
ake himself at home easily and com-
rtably. The latch string is out.

xport: 230 Park Ave., New York 17,
N. Y., U. S. A.

JONES & LAUGHLIN

Subsidiary of Jones & Laughlin Steel Corporation

Stores and offices in all oil areas East of the Rockies



SUPPLY COMPANY

TULSA, OKLAHOMA

General Offices

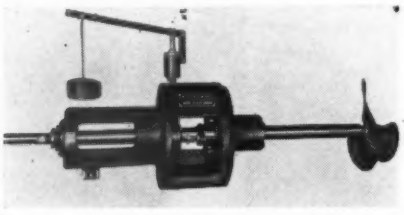
J&L STEEL

173

MIXING EQUIPMENT CO.
California Bldg., Booth 4

Will Exhibit: "Lightnin" propeller type agitators for slide or top mounting in tanks.

New: "SE" Series Side Entering Mixer for gasoline blending and other refinery operations. Unit can be repacked from outside the tank, and is complete as furnished requiring no outboard bearing.



Mixing Equipment Co.'s Model "SE" Mixer

174

MULTI-METAL WIRE CLOTH CO., INC.
Kansas Bldg., Booths 30-31

Will Exhibit: Fabricated wire and filter cloth units made especially for the petroleum industry; 12 ft. clay tower screen, vibrating screen cloths, filter leaves, catalyst screens, pipe line strainers, grease strainers and cartridges.

New: Bulletin on "Wire and Filter Cloth for the Petroleum Industry."

Representatives: Lloyd Hopkins, sales manager; Alfred Stern, Joseph Wilker, Nicholas Gaug, and Philip Broad.

175

NATASCO CO.
Scientific & Technical Bldg.
Booths 69-70

Will Exhibit: Equipment and products designed to protect steel storage tanks against corrosion.

176

NASH ENGINEERING CO.
Kansas Bldg., Booths 39-40, 65-66

Will Exhibit: Non-lubricated air and gas compressors, laboratory pumps, and centrifugal pumps of "Pyrex" glass to be shown in actual operation.

Representatives: Irving C. Jennings, president; Edward A. Mead, gen'l sales manager; Harold E. Adams, chief engineer; George B. Wright, publicity manager; John B. Wright and Fred Green.

177

NATIONAL FOAM SYSTEM, INC.
Kansas Bldg., Booth 38

Will Exhibit: "Aer-O-Foam" nozzles, pump proportioners, foam chambers and foam makers; "Aer-O-Foam" liquid; "Fomon" foam generator powder, generators, nozzles; "Fomon" foam charges for 2½ gal. extinguishers.

Representatives: E. P. Hughes, ass't to the president; Emory Eysmans, ass't sales manager.

178

NATIONAL LEAD CO.
Scientific & Technical Bldg.
Booth 50

Will Exhibit: A mechanical book with self-turning pages showing photographs of lead installations common to the oil industry and of lead products—sheet, pipe, coils, valves, fittings.

179

NATIONAL TECHNICAL LABORATORIES (Beckman Instruments)
Scientific & Technical Bldg.
Booth 79

Will Exhibit: Beckman Model DU Quartz Spectrophotometer, Flame Spectrophotometer, portable pH Meters, and Radiation Meters.

New: Model H-2, AC-operated pH Meter for laboratory use and portable Model M pH Meter for field use.

Representative: T. F. Herring, vice-president.

NATIONAL TUBE CO.
Oklahoma Bldg., Booths 136-148

See listing under United States Steel Corp.

180

NELSON ELECTRIC MFG. CO.
Oklahoma Bldg., Booth 168

Will Exhibit: Instrument panel; generator control panel; explosion proof motor starters; explosion proof circuit breakers; control stations; time delay push button stations; insinulated pipe line flanges.

Representatives: H. A. Norberg, Dick Ray, R. S. Terhune, Tom Feurt, Curtis Oakes.

181

NORDSTROM VALVE DIV. ROCKWELL MFG. CO.
Scientific & Technical Bldg.
Booths 33-38

Will Exhibit: Lubricated plug valves in a complete range of sizes, types, metals; working pressures from 175 to 10,000 psi.; wrench, gear, or power operated.

182

OAKITE PRODUCTS, INC.
Texas Bldg., Booths 22-23

Will Exhibit: Steam-detergent vapor cleaning unit; interior tank cleaning unit, Model 324; solution-lifting steam guns; chemical descaling and degreasing compounds.

New: Steam vapor cleaning unit; and Model 324 Interior Tank Car Cleaning Unit, which cleans tank cars automatically in about two hours time.

Representatives: V. Bowes, V. L. Baltzell, S. C. Shank, J. R. Whyte, S. F. Hagler, R. Ham, L. W. Cunningham, H. T. Hancock, and T. C. Zimmerman.

183

OHIO INJECTOR CO.
Oklahoma Bldg.,
Booths 219-220, 231-232

Will Exhibit: "OIC" cast steel, forged steel, stainless steel, iron, and bronze valves.

Representatives: Wayne Young, president; P. M. Arnall, exec. vice-president; E. A. Young, vice-president; Howard G. Doster, vice-president; W. G. Shepard, W. C. Davis, M. W. Pauly, A. A. Kruse, Paul E. Banks, E. G. Blaylock.

184

OHIO STEEL FOUNDRY CO.
Texas Bldg., Booths 78-79

Will Exhibit: "Ohio" welding type fittings, return bends, and castings; "Fahrite" stainless steel alloy castings, refinery tube supports, sheets, and hangers.

New: "Ohio" Type 1640 return bend in four series—800, 1250, 1600, and 2000 psi., for temperatures up to 1100° F., in carbon steel, carbon moly steel, 4-6% Chrome, 50 Moly Steel, and 2% Chrome, .50 Moly steel. Bulletin No. R-947 covers this return bend line.

Representatives: T. H. Harvey, vice-president; J. D. Hagans, sales manager; J. G. Palmer, I. D. Cline, and W. K. Rider.

OLIVER UNITED FILTERS, INC.
Park Lane, Booth 4

For more information on these items, use reply card opposite p. 496.

SARGENT POLAROGRAPH

MODEL XXI IMPROVED REDESIGNED

On exhibit at Booth 26
International Petroleum Exposition
Scientific & Technical Building

The Sargent Polarograph, Model XXI, Represents the Latest Development in Polarographic Instrumentation

This potentiometric, visible-recording instrument is the successor to the well-known Model XX and embodies several new features of construction and design.

A twenty-step integrally variable sensitivity control assures more positive sensitivity reproduction.

An R. C. filter type damping control, for placing a capacitance in parallel with the measuring resistor at high sensitivity settings and an additional series resistor and parallel capacitance at low settings, has been substituted for the straight capacitance type.

A new switch arrangement permits initial potential to be applied either in the same direction as the span potential or counter to it.

The bridge has been completely enclosed, heavier wire used throughout and the unitized panel construction of the Polarograph circuit permits it to be removed from the instrument case, in one piece, for servicing.

The instrument is slightly smaller than the former Model XX and has the following characteristics:

Current Sensitivity Range .003—1.500 microamperes per mm.

Inherent limit of Instrumental accuracy 0.5% of the current measured.

Time of full scale traverse, 10 seconds.

Time of rotation of bridge, 13½ minutes.

Power consumption, 100 watts.

S-29303 POLAROGRAPH—MODEL XXI, Visible Chart Recording, Sargent. Complete with accessories. For operation from 115 volt 50/60 cycle circuits.....**$1500.00**

SARGENT

SCIENTIFIC LABORATORY EQUIPMENT AND CHEMICALS

E. H. SARGENT & COMPANY, 155-165 EAST SUPERIOR ST. ·CHICAGO 11, ILL.

MICHIGAN DIVISION *1959 EAST JEFFERSON DETROIT MICHIGAN*

OWENS-CORNING FIBREGLAS CORP.
Kansas Bldg., Booths 97-98, 119-120

185

PACIFIC PUMPS, INC.
Dresser Industries Bldg.
Block 11

Will Exhibit: Single, two and multi-stage centrifugal pumps; vertical centrifugal pumps. Cutaway models of two types of pumps.

New: Type F Pipeline Pump, a multistage centrifugal, and Bulletin 103 giving a description.

Representatives: A. R. Weis, president; E. J. Weis, vice-president & sales manager; Roy Dunbar, president, mid-continent division; M. F. Ecker, F. P. Applegate, A. F. Canada, Jr., and W. R. Carlson.

186

PETRO-CHEM DEVELOPMENT CO.
Bethlehem Supply Co. Bldg.

Will Exhibit: A Petro-Chem Iso-Flow Furnace

Representative: T. B. Leech, manager of refinery sales, Bethlehem Supply Co., Tulsa, Okla.

187

PETROLEUM ENGINEERING, INC.
Oklahoma Bldg., Booth 222

Will Exhibit: Photographs, advertising and other descriptive literature pertaining to natural gasoline plants, cycling plants, and appurtenant equipment used in their operation.

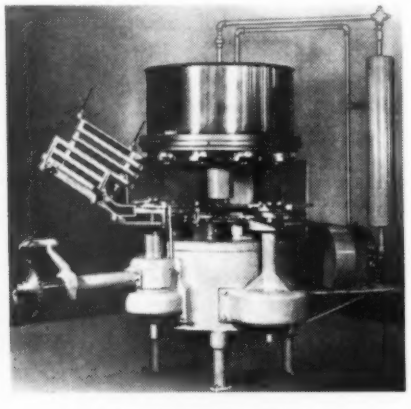
Representatives: Paul M. Raigorodsky, president; W. A. Stover, chief engineer; Edwin Norman, purchasing agent.

188

PFAUDLER CO.
Kansas Bldg., Booths 52-53

Will Exhibit: Glass-lined processing equipment; reactors, one to 500 gal. capacity; pipe and fittings suitable for pressures up to 300 psi.

New: High-speed vacuum can filling machine, one to 18 stations.



Pfaudler's Can Filler

Representatives: George F. Kroha, vice-president; P. S. Barnes, manager, chemical sales; C. M. Clark, advertising manager; W. D. Phetteplace, Allan Herrick, F. B. Morris, and B. E. Albain.

189

PITTSBURGH STEEL CO.
Texas Bldg., Booths 4-6

Will Exhibit: Tubular goods, mechanical tubular products, fencing.

Representatives: J. H. Carter, J. K. Beeson, J. A. Voelker, G. A. Connors, C. L. Zak, E. R. Smith, A. S. Vandervort, Jr., H. S. Dershimer, T. R. Miller, G. W. Novak, J. D. Smith, J. Simonin, John Wais, and W. Rowe.

190

PITTSBURGH VALVE & FITTINGS CORP.
Silver Lane, Booths 36-37

Will Exhibit: Malleable pipe fittings; plug valves; bronze valves, 100 to 2000 psi.; iron valves, 125 to 1200 psi.; and iron cocks, 175 to 350 psi.

New: "Hydro-Lube" lubricated plug valve, 1 to 4 in., 175 psi., W.O.G. working pressure, 350 psi. test, screwed or flanged ends, wrench operated, temperature range 25 to 125° F., suitable for service on water, brines, alcohol, caustic solutions, and ketones.

Representatives: L. D. Seymour, vice-president; W. C. Goza, gen'l sales manager; T. W. Harvey, chief engineer; E. L. MacBlain, M. A. Bradburn, C. E. Piper, N. G. Simpson, and A. E. Erickson.

191

PLASTELITE ENGINEERING CO.
Silver Lane, Booth 14

Will Exhibit: Electrically-insulated pipe line fittings; piston rings and complete plastic pistons; compressor valve plates and rod packing; pump valve discs and seats.

New: Compressor valve plates designed for large reciprocating compressors handling corrosive gases. They are non-corrosive, rust-proof, high in mechanical strength, and are reported to outlast steel plates 5 to 1. Plastic pump valve seats are designed for large pumps handling sour crude oil, salt water, or other corrosive fluids. Will withstand pressures up to 1500 psi.

Representatives: R. L. Adams, C. F. McCamly, for Plastelite Engineering Co.; J. A. Clay, Jr., and G. G. Crawford for Service Engineers, Inc.; and R. W. Lytle for Formica Insulation Co.

192

H. K. PORTER CO., INC.
Block 5

Will Exhibit: Cut-away section, flanged-mounted, side-entering agitator; scale working model, side-entering agitator; screw pumps; "Rotex" gear pumps; plug and gate valves; jacketed fittings; springs; couplings; heat exchangers; condensers; pressure vessels.

New: The Porter Lubricated Plug Valve, and the "Nail-It-Kwik" Coupling.

Representatives: T. M. Evans, president; C. R. Dobson, vice-president; W. W. Calihan, director of sales; A. C. Hauser, ass't. director of sales; A. D. MacLean, N. Cleary, E. M. Bardo, H. H. Lewis, H. A. McCoy, R. E. Nelson, and G. L. Phillips.

193

WM. POWELL CO.
Texas Bldg., Booths 1-2

Will Exhibit: Globe, angle, check, and gate valves in bronze and iron for water, oil, gas, and low pressure steam services; cast steel valves (classes 150 to 2500 W.S.P.) for high pressure and high temperature service.

Representatives: E. K. Pierce, vice-president; L. E. Battin.

194

%PROPORTIONEERS, INC.%
Oklahoma Bldg., Booth 329, and Demonstration outside Hall of Science

Will Exhibit: Proportioning and blending equipment for the petroleum industry; high pressure plunger type proportioning pumps, and low pressure diaphragm type proportioning pumps.

New: Demonstration of the "Loss-in-Weight" Blender for "on-stream" addition of anti-knock compounds to motor fuels; "Volumetric Blender" for lubricating oils, gasolines, etc.

Representatives: In Oklahoma Bldg.—H. W. Arduser, R. P. Lowe, and P. V. Crowther; at demonstration trailer near Hall of Science; H. W. Arduser and Herbert Hollberg.

195

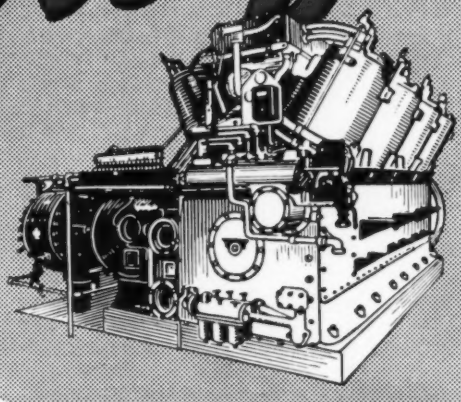
PYRENE MFG. CO.
Oklahoma Bldg., Booths 38-39

Will Exhibit: Demonstrations of

For more information on these items, use reply card opposite p. 496.

Another Example of Efficient Power at Lower Cost

Announcing Cooper-Bessemer Turboflow



V-ANGLE, ENGINE-DRIVEN COMPRESSORS • 200 TO 2400 HP

Why this new development can cut your costs!

1. *15% less fuel consumption!*

Due to efficiency unapproached by any other 2-cycle gas engine, the fuel consumption *guarantee* is 8,500 BTU per hp hour instead of the customary 10,000 BTU. It's *easily* met . . . fully proved!

2. *10% more power!*

Compared with old-style engines of the same size, the Turboflow engines pull at least 10% more maximum load without encroaching on their overload capacity, thus more than justifying a 10% higher continuous rating . . . *and without any increase whatever in foundation, housing or piping requirements!*

3. *Tremendous savings!*

Entirely aside from remarkable fuel economy, it takes *fewer* engines and *less* space to meet total power needs. Thus the over-all cost per horsepower for installation, housing, operating personnel, maintenance, part replacement and general overhead is greatly reduced!

Why not check with the nearest Cooper-Bessemer office and get complete information on the adaptability of this money-saving development to your particular needs?

The **Cooper-Bessemer** *Corporation*

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York City Washington, D. C. Bradford, Pa. Parkersburg, W. Va. San Francisco, Calif. Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle, Wash. Tulsa, Okla. Shreveport, La. St. Louis, Mo. Los. Angeles, Calif. Caracas, Venezuela Gloucester, Mass. Calmes Engineering Co., New Orleans, La.

actual oil fire extinguishment under emergency conditions. Illustrating the smother technique, the company will use a fixed air foam system and a portable air foam playpipe to put out fires in a large pit. Demonstrations daily, weather permitting. Place and time will be announced. Two models, about 30 in. square, of oil tank farms: one shows how an air foam system with proportioning tank is erected to protect oil tanks 20 to 45 ft. in diameter, the other illustrates the use of an auto-induction air foam system to guard tanks of the largest size now in use.

New: Continuous showing of technicolor motion picture, "Fire and Ice" (See also C-O-Two Fire Equipment Co. listing, a Pyrene affiliate.)

Representatives: J. P. Maloney, gen'l field sales manager; James Faulkner, J. M. Walsh, Jr., Alonzo S. Anderson, and Patrick D. Kelly.

196

QUIGLEY CO., INC.
Scientific & Technical Bldg.
Booth 1

Will Exhibit: Bonding mortars for fire brick; lightweight, medium weight, and heavy weight castables; plastic fire bricks; insulating fire brick; Missouri and Pennsylvania brands of fire brick; chrome plastic; chrome bonding mortar; water-resistant insulation with a wide temperature range; acid-proof cements; pipe thread joint sealing compounds; and industrial paints.

Representatives: S. F. Murphy, Jr., vice-president, sales; J. W. Riddle and I. A. Pfeil.

197

QUIGLEY PANEL CONSTRUCTIONS, INC.
Scientific & Technical Bldg., Booth 2

Will Exhibit: Precast insulating refractory panels, many of which are now in use in high-octane gasoline plants. Standard panels are provided with one imbedded thread attachment for each square foot, flush with the back of the panel. Special shapes also available.

Representative: H. C. Thayer, vice-president and chief engineer.

198

REFINERY SUPPLY CO.
Scientific & Technical Bldg.
Booths 8-10

Will Exhibit: Reid vapor pressure bombs and gages; smoke meter for determining smoke density in stack gas; dew point tester for gas under pressure, Bureau of Mines type; dead weight testers; "Acme" gas gravity balance, adopted by the NGAA as means for determining specific gravity of natural gas.

New: Improved models of cement slurry testers and recording gas gravitometer with controller.

Representatives: W. A. Schlueter, president; J. B. Okeson, sales manager; H. F. Goodenough, chief engineer; T. C. Williams, V. F. Sweeney; Karl Weiss, and Charles Hinkle.

199

REPUBLIC STEEL CORP.
Kansas Bldg., Booths 102-115

Will Exhibit: Pipe, tubing, alloy and stainless steel, bolts and nuts, containers, bubble caps, and products of Republic customers.

New: Two pieces of literature, one on electric weld pipe, the other on continuous weld pipe.

Representatives: Manley Brown, sales manager, pipe; Forrest Ramage and William Fruhan, ass't. managers; Chester W. Ruth, director of advertising; E. E. Haubegger, Houston district sales manager.

200

RIDGE TOOL CO.
Texas Bldg., Booths 28-30

Will Exhibit: Pipe tools; wrenches, threaders, cutters, vises, extractors, reamers, cutting machines.

New: No. 4P geared pipe threader for 2½ to 4 in. pipe; "Ridgid Porta-Power" Machine, for operating hand threaders, cutter and reamers, weighing only 100 lbs., handles ⅛ to 2 in. pipe, ¼ to 1½ in. bolts.

Representatives: W. L. Parcell, sales manager; Ralph Chamberlin, Robert D. Fye, Seth W. Smith, and E. C. Bliss.

201

ROCKWELL MFG. CO.
HYDRAULICS DIV.
Scientific & Technical Bldg.
Booths 33-38

New: Rockwell "Rotocycle" Pump, of fixed volume, double acting type with all parts held in hydraulic and dynamic balance, particularly suited in design for pumping non-lubricating liquids.

202

ROOTS-CONNERSVILLE BLOWER CORP., Block 11

Will Exhibit: Centrifugal and rotary positive displacement type blowers, exhauster, and gas pumps for refining and petroleum processing applications. The company manufactures a standard line of rotary units from 10 to 50,000 cfm., and centrifugal units from 2,000 to 100,000 cfm. capacity.

203

E. H. SARGENT & CO.
Scientific & Technical Bldg.
Booth 26

Will Exhibit: Polarographs, constant temperature viscosimeter bath, stirring motors, ASTM approved hydrometers and thermometers.

New: Model XXI improved and redesigned Polarograph; current sensitivity range 0.003 to 1.500 microamps./mm., inherent limit of accuracy, 0.5% of the current measured; time of full scale traverse, 10 secs.; time of rotation of bridge, 13½ minutes; power consumption, 100 watts. New model cone-drive stirring motor.

Representatives: Robert J. Reinarts, sales manager; R. L. Osburn and Ray Moser.

SERVICE ENGINEERS, INC.
Silver Lane, Booth 14

See listing under Plastelite Engineering Co.,

S K F INDUSTRIES, INC.
Texas Bldg., Booths 67-68

204

A. O. SMITH CORP.
Oklahoma Bldg., Booths 177-180

Will Exhibit: Large diameter line pipe; pressure vessels—carbon steel, alloy lined, clad, solid alloy, multilayer for extremely high pressures; liquid gas systems; measuring meters, level gages, welding electrodes; liquid gas water heaters.

Representatives: R. J. Amann, A. E. Butts, Norman George, Jack Blanco, J. C. Riley, Jr., J. F. Donnelly, H. H. Needham, J. P. Parker, W. R. Kepler, D. F. McCarthy.

SMITH METER CO.
Scientific & Technical Bldg.
Booths 83-84

SPARKLER MFG. CO.
Scientific & Technical Bldg.
Booth 14

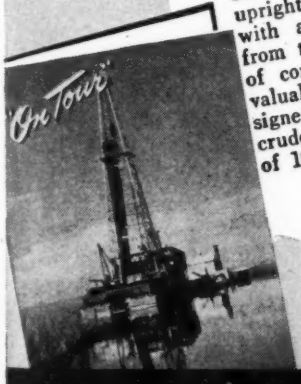
Will Exhibit: Demonstration of

For more information on these items, use reply card opposite p. 496.

Oleum Refinery

PETRO-CHEM HEATER When Oleum's Unit 200, called a delayed coking unit, goes on stream early this fall, Union Oil Company will unveil one of the newest designs in petroleum processing heaters, the second one of its kind in service in the Bay Area.

Unlike the conventional tube-still heaters seen in refineries, the Petro-Chem version employs vertical tubes mounted in an upright cylindrical steel structure (above), with an integral stack rising vertically from the combustion chamber. This type of construction uses less of a refinery's valuable space. The heater has been designed to handle 19,500 barrels a day of crude petroleum, has an external diameter of 19 feet, and a total height of 105 feet.



seeing is believing

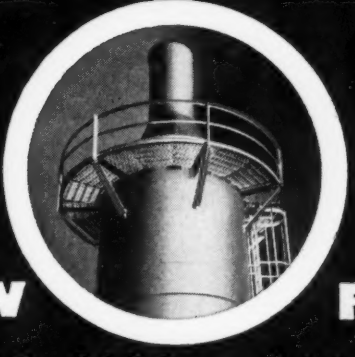
UNION OIL COMPANY

UNVEILS ONE OF THE NEWEST DESIGNS IN PETROLEUM PROCESSING HEATERS*

. . . and tells the world about it in their company magazine "On Tour".

A PETRO-CHEM ISO-FLOW FURNACE *OF COURSE!

*Reproduced through the courtesy of The Union Oil Company magazine "On Tour" September 1947 — Vol. 9 Number 9.



PETRO CHEM

ISO-FLOW FURNACES

UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

PETRO-CHEM DEVELOPMENT CO., INC., 120 EAST 41ST STREET, NEW YORK 17, N. Y.

Representatives: Bethlehem Supply Co., Tulsa and Houston • Lester Oberholtz, Calif. • D. D. Foster Co., Pittsburgh • Faville-Levally Corp., Chicago

three models of horizontal plate type industrial filters.

New: Special filter designed for fuel and lubricating oils.

Representatives: A. C. Kracklauer, president; Arthur Laqueur, W. J. Kracklauer, and Frank Neil.

205

SQUARE D CO.
Oklahoma Bldg.,
Booths 60-61.

Will Exhibit: Electrical power control equipment; circuit breakers; switching relays and timers; contactors and starters; fusible switch type pumping plant panel; equipment for hazardous locations; two operating displays indicating desirable characteristics of oil tight push-button stations; manual and magnetic starters; limit switches.

Representatives: F. H. Roby, ass't. gen'l sales manager; C. L. Hull, merchandising sales manager; Ray Walker, regional manager; W. H. Bodle, E. Love, and W. E. Neal, sales engineers.

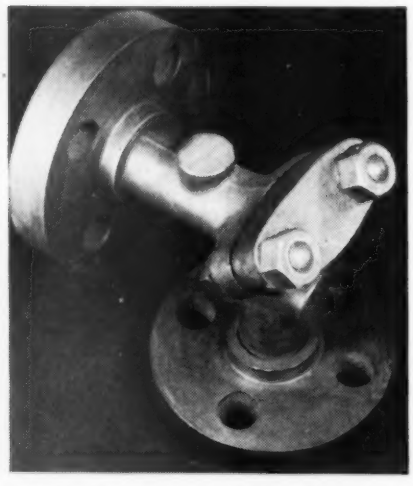
206

STEEL IMPROVEMENT & FORGE CO.
Oklahoma Bldg., Booth 229

Will Exhibit: Boiler accessories, valve parts, coupling parts, fitting blanks, and "Gruv-Seal" ring gaskets.

New: New intricate forgings for valves and tools; Catalog No. 11, "Boiler and Tank Accessories," and Catalog No. 21, "Improvement of Metals by Forging."

Representatives: C. H. Smith, Jr., president; H. A. Zimmerman, sales manager; P. A. Domino, ass't. sales manager; T. L. Moore, and H. M. Dunn.



Typical intricate forging by Steel Improvement & Forge Co.

STERLING PACKING & GASKET CO.
Park Lane, Booth 7

STRUTHERS WELLS CO.
Kansas Bldg., Booth 77

207

TAYLOR FORGE & PIPE WORKS
Bethlehem Supply Co. Bldg.

Will Exhibit: Welding fittings and forged steel flanges; welding fittings and flanges in aluminum, monel, nickel, inconel, and stainless Types 304, 314, and 347; and spiral welded pipe.

New: Bulletin 476 giving dimensional data on stainless steel fittings from ¾ to 12 in., and light-weight American Standard flanges from ¾ to 30 in.

Representatives: Paul R. Bush, Chicago sales; and Stanley Gill, Houston district manager.

208

TAYLOR INSTRUMENT COS.
Scientific & Technical Bldg.
Booths 87, 31-32.

Will Exhibit: The flow line of instruments, aneroid and mercurial manometers, transmitters, and receiving controllers. One section will be devoted to the Taylor Integrator.

New: An all stainless steel, 300 psi. aneroid manometer; a pitot-venturi; and a pre-calibrated orifice section.

Representatives: F. S. Ward, industrial sales manager; A. J. Fleig, divisional sales manager; R. E. Clarridge, manager, application engineering department; R. E. Flikkema, Tulsa manager; G. E. Howard, R. Van De Carr, O. F. Hunter, A. R. Wagner, R. E. Bailey, and J. C. Laley.

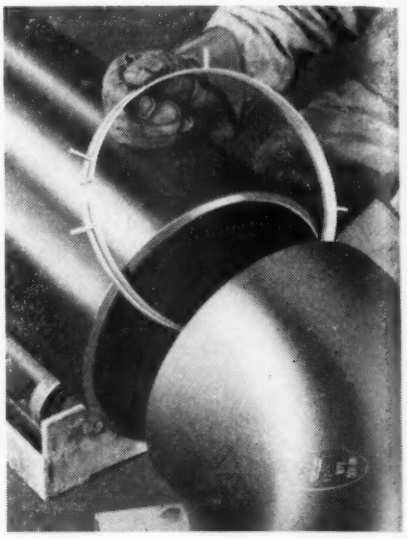
TENNESSEE COAL, IRON, AND RAILROAD CO.
Oklahoma Bldg., Booths 136-148

See listing under United States Steel Corp.

209

TIMKEN ROLLER BEARING CO.
Oklahoma Bldg., Booths 149-150

Will Exhibit: Steel and seamless steel tubing. In background will be an illuminated world map with all oil producing areas indicated by alternately brightening and dimming spots. Photographs of the crowd taken by a roving candid camera-



Tube Turns' Grooved Type Knockoff Spacer Pin Welding Ring

man will be posted on a bulletin board and given free of charge to each subject.

210

TRETOLITE CO.
Block 4

Will Exhibit: Chemical reagents for dehydrating and desalting crude oils.

211

TUBE TURNS, INC.
Texas Bldg., Booths 132-133

Will Exhibit: Complete line of welding fittings and flanges with emphasis on wide range in materials available, stainless steel, aluminum, chrome-moly, inconel, nickel (pure and 3½%).

New: Improved Tee design engineered to withstand pressures 25% higher than ratings established for conventional design; Grooved Type Knockoff Spacer Pin Welding Ring.

Representatives: J. G. Seiler, vice-president and gen'l sales manager; T. H. Pike, Jr., ass't sales manager; W. B. Whenthoff, Houston district office manager; R. S. Tyler, Tulsa district office manager.

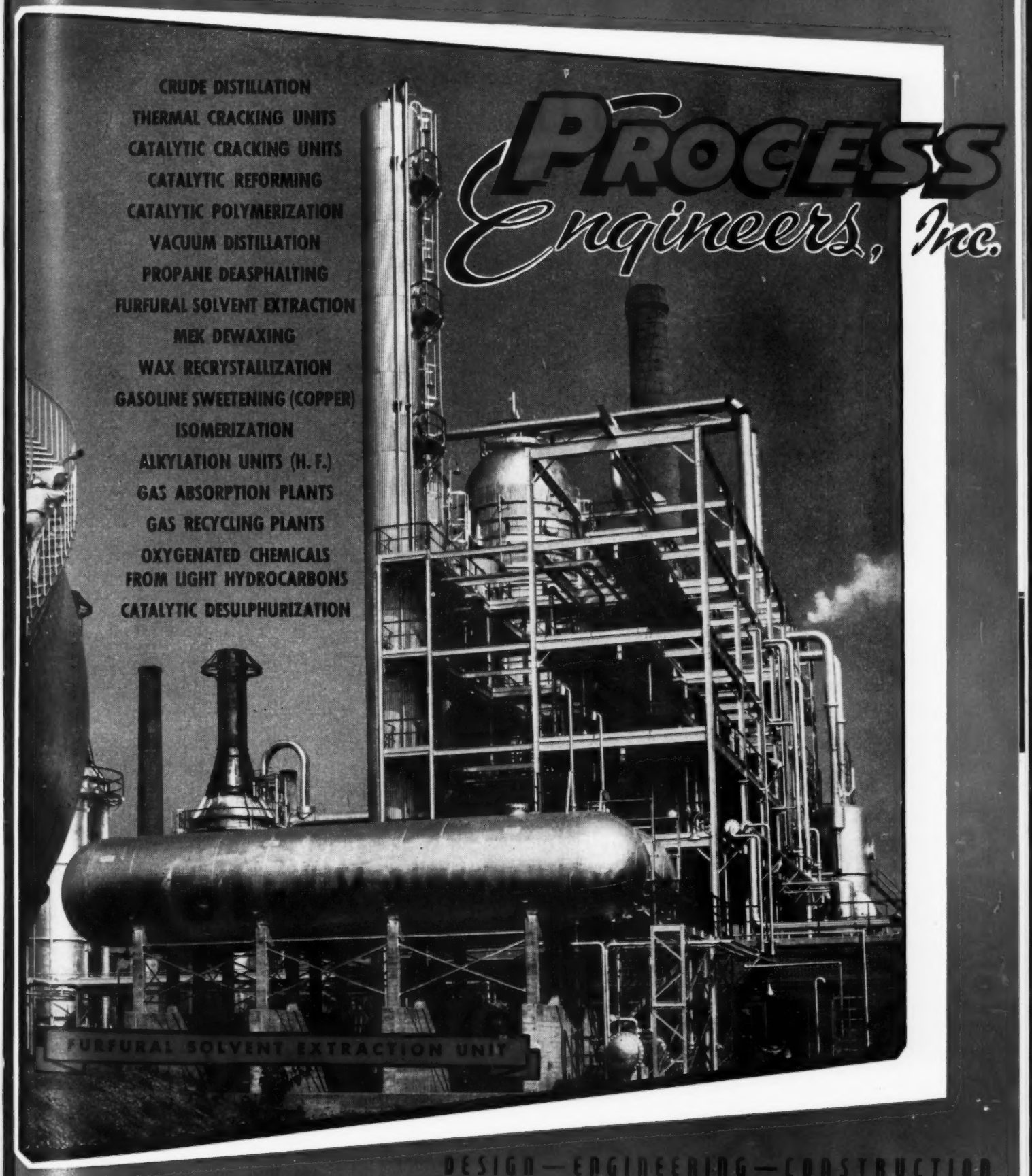
212

TYSON BEARING CORP.
Kansas Bldg., Booth 63

Will Exhibit: Tyson "All Rolls" design tapered roller bearings.

Representative: George C. McMullen, vice-president, in charge of booth.

For more information on these items, use reply card opposite p. 496.



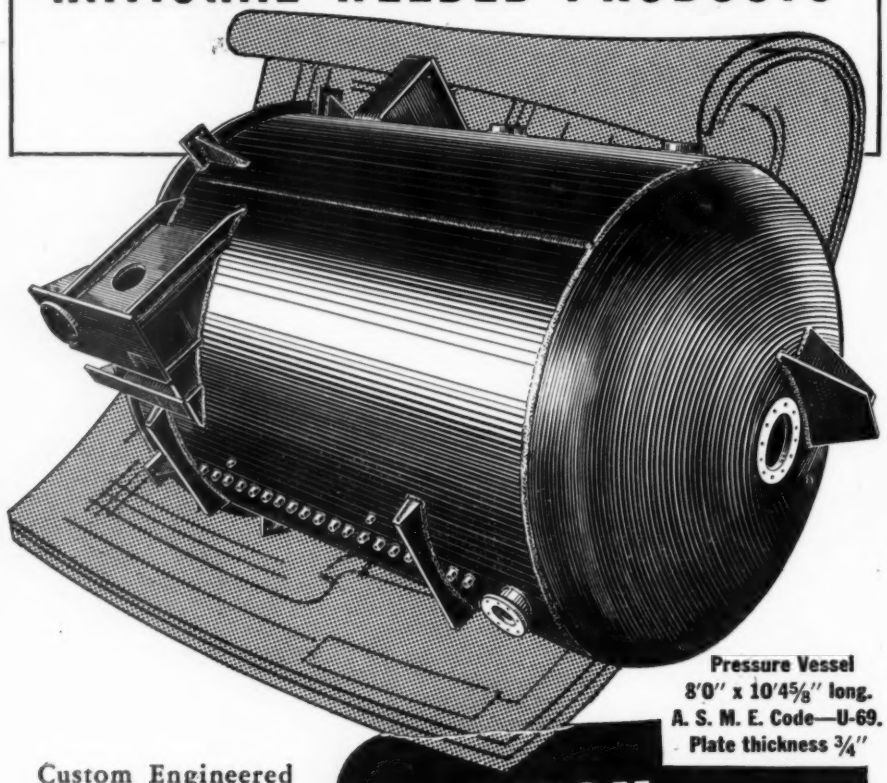
DESIGN — ENGINEERING — CONSTRUCTION

FOR PETROLEUM REFINING — GAS — PETRO-CHEMICALS

PROCESS ENGINEERS' Engineering Division is staffed with competent process engineers and designers to cover all phases of refinery design and engineering, procurement of materials and erection supervision. Our services include the design and construction of natural gasoline absorption plants, gas recycling and repressuring plants, appraisals, reports and consulting services on operating problems of refineries and natural gasoline plants. The Petro-chemical Division can offer oxygenated chemicals produced from light hydrocarbons.

2409 ROSS AVENUE — DALLAS, TEXAS

NATIONAL WELDED PRODUCTS



Pressure Vessel
8'0" x 10'4⅝" long.
A. S. M. E. Code—U-69.
Plate thickness ¾"

★ CUSTOM ENGINEERED

TO MEET EXACTING CODES AND REQUIREMENTS

FROM OPEN HEARTH, STAINLESS, ALLOY AND CLAD STEELS

Custom Engineered by NATIONAL means reliable and durable equipment for the chemical, processing and petroleum industries. All manufacturing operations such as forming, welding, stress relieving and machining are performed within our own plant—under the constant protection of X-ray and manual inspections.

NATIONAL will gladly work with you while your plans are in the formative stages, or from completed blue prints. Write for Bulletin which shows our complete fabricating facilities.

NATIONAL PRODUCTS

- Pressure Vessels
- Galvanizing Kettles
- Annealing Covers
- Tin Pots
- Salt Annealing Pots
- Wire Annealing Pots
- Special Plate Work

National
ANNEALING BOX COMPANY
API-ASME Codes • Stress Relieving • X-ray
Pledged to Quality Since 1895
WASHINGTON, PENNA.

213

UNITED STATES STEEL CORP. AND SUBSIDIARIES
Oklahoma Bldg., Booths 136-148

Will Exhibit: USS Stainless steel in actual demonstrations of bending, forming, and shearing strip, bar, and tubular stock; applications of other types and grades of alloy and carbon steels made by Carnegie-Illinois Steel Corp., Columbia Steel Co., and Tennessee Coal, Iron, and Railroad Co.; demonstration of applications and properties of National Tube Co. products including refinery still tubes, and a unique underground gas storage unit consisting of 40-ft. sections of 24-in. seamless tubing fabricated into containers; wire rope and cables made by American Steel & Wire Co.; wire strapping machines by Gerrard Steel Strapping Co.; specialties by the United States Steel Supply Co.; various barges and structures by American Bridge Co.; and fencing by Cyclone Fence Division of American Steel & Wire Co.

214

UNITED STATES STEEL SUPPLY CO.
Oklahoma Bldg., Booths 136-148

See listing under United States Steel Corp.

215

UNIVERSAL OIL PRODUCTS CO.
Scientific & Technical Bldg.
Booths 73-74

Will Exhibit: Operating model of Fluid catalytic cracking process; photographs illustrating the typical activities of the company in research, development, engineering, refinery planning, field service, and inhibitors.

Representatives: Harvey W. Blankenship and W. E. Lemen.

216

VAPOR RECOVERY SYSTEMS CO.
Oklahoma Bldg., Booths 80-81

Will Exhibit: Following approved VAREC products: conservation vent unit Fig. No. 58A, back pressure regulator Fig. No. 190G, Vacuum relief valve Fig. No. 360, pressure and vacuum relief valve Fig. No. 482A, automatic tank gauge Fig. No. 253 (operational mock-up), gauge and thief hole cover Fig. No. 40, swing line assembly (operational mock-up), vapor recovery regulator Fig. No. 180 (sectional unit), nozzle-type angle relief valve Fig. No. 78 (sectional unit).

New: Sampling bottle cage Fig.

For more information on these items, use reply card opposite p. 496.

DOUBLE DECK—DOUBLE CHECK

If filling losses far exceed standing losses in your storage installation, the Graver Improved Floating Roof *with full double deck* is your best protection. It's designed to prevent all the filling losses *plus* as high as fifty percent of the standing losses . . . the greatest possible overall saving for such set-ups as a deep water terminal.

The double deck, in addition to providing a buoyancy that is positive assurance against sinking under any conditions of weather or climate, insulates the stored product effectively against "boiling". Lying directly upon the surface of the liquid and sloping upward from the center, the roof eliminates the accumulation of vapor which causes corrosion where "sour" crudes are stored.

For a double check where filling losses are the major problem, specify the Graver Floating Roof with full double deck.

FABRICATED PLATE DIVISION

GRAVER TANK & MFG. CO., INC.

East Chicago, Indiana

Graver offers a complete service to the petroleum industry including Expansion Roof Tanks, Floating Roof Tanks and pressure vessels. In addition, Graver is prepared to furnish specialized steel plate work such as fractionating columns and class one vessels as well as stainless and alloy fabrication; water conditioning equipment of all types; and through the Graver Construction Co., is prepared to handle all types of petroleum and chemical construction work.

GRAVER

NEW YORK • PHILADELPHIA • CHICAGO • CATASAUQUA, PA. • HOUSTON • SAND SPRINGS, OKLA.

Vapor Recovery System's sample bottle cage

425, for obtaining spot or running samples in a 32 oz.-bottle through an opening of 4⅞ in. or larger. Cage is constructed of non-sparking material. Sample bottle is uncorked by slight jerk on chain. Other new items include anti-freeze water draw-off valve Fig. 503; modified internal safety valve Fig. 507; and modified combination vent valve and gauge hatch Fig. 23.

Representatives: Frank V. Long, president John L. Shaunty, midcontinent sales manager; A. D. Scotty and William Worsham, sales engineers.

VINSON SUPPLY CO.
Texas Bldg., Booths 76-79

WAILES DOVE-HERMISTON CORP.
Texas Bldg., Booths 73-75

217

WALWORTH CO.
Oklahoma Bldg., Booths 103-108

Will Exhibit: Cast steel gate valves; lubricated plug valves; bronze valves, including the No. 91 globe valve for butane service; steel and stainless steel pressure-seal gate valves; pipe fittings in steel, iron, and bronze; "Walseal" threadless bronze fitting for making "Silbraz" joints.

Representatives: A. J. Eichler, vice-president, sales; J. D. McManus, chief engineer; W. M. Combs; E. L. Clark, C. G. Finkle, H. C. Nannen, L. F. Lamberty, John Rice, J. G. Younggren, W. H. Weber, F. S. Markle, R. S. Fraysier, Joe Kaye, and E. B. Marrs.

218

WARNER LEWIS CO.
California Bldg., Booth 59

Will Exhibit: "Excel-so" separators, filters, separator-filters, calibrating tanks and separator-dehydrators for refineries, natural gasoline plants, and pipe lines. Units range up to 1500 gpm. capacity.

New: A combination "FE" Separator-Filter, operating in three stages; the first removes pipe scale and other large bodies of foreign matter, the second removes particles 25 microns or larger, and the third, particles 10 microns and smaller.

Representatives: Warner Lewis, president; W. A. Gresh, chief engineer; Charles Britten and J. O. Morrow, sales.

219

WATSON-STILLMAN CO.
Oklahoma Bldg., Booths 223-224

Will Exhibit: Forged steel pipe fittings; portable hydraulic pipe bender; 30 ton hydraulic laboratory press; independent pump hydraulic jack, 50 ton capacity.

Representatives: A. G. York, vice-president; J. P. Bittenbinder, ass't sales manager; C. Johnson, design engineer.

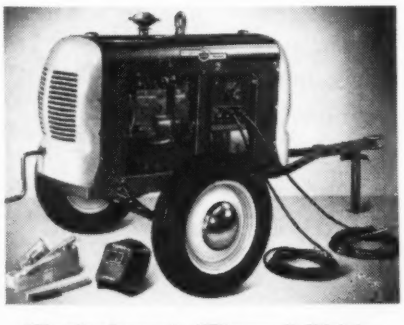
220

WESTINGHOUSE ELECTRIC CORP.
Oklahoma Bldg., Booths 21-23, 118-120

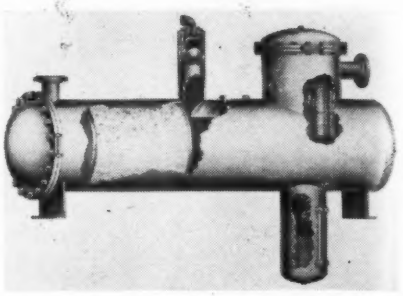
Will Exhibit: All-steel "LifeLine" motor, airbreak combination line-starter for hazardous locations, and portable AC and DC welders.

New: The "Flexarc" AC welder, said to overcome the problems of arc instability which formerly limited the use of lower AC voltages for welding. It is designed to operate with an open circuit secondary voltage of only 65 volts.

WILSON-SNYDER MFG. CO.
Block 2



Westinghouse's "Flexarc" Welder



Warner Lewis' combination Separator-Filter

W K M CO.
Texas Bldg., Booths 18-21

221

WORTHINGTON PUMP & MACHINERY CORP.
Block L

Will Exhibit: Diesel engines; variable flow reciprocating pumps; rotary pumps; centrifugal pumps for refineries and pipelines; vertical compressors; portable compressors; turbines.

New: A 2¼ by 6, Type VTEV "Variflo" reciprocating pump will be demonstrated to show the action of variable stroke. Two new centrifugal pumps and a model of a new mechanical seal. A centrifugal propane compressor, the Model GUR-5L4.

Representatives: E. J. Schwanhausser, vice-president, sales; J. V. Jirasek, F. J. Ellis, G. F. Habach, A. M. Tullo, E. F. Wright, J. Charles, W. B. Strong, W. E. Wechter, P. A. Mack, T. J. Kehane, H. Garner, H. Boteler, A. C. Ross, G. Steven, and J. J. Ball.

YOUNG RADIATOR CO.
West of Block U

YOUNGSTOWN SHEET & TUBE CO.
Blocks 6-7-8

222

JOHN ZINK CO.
Silver Lane, Booths 3-4

Will Exhibit: Standard "Bi-Mix" and "Center-fired" Series Y refinery burners; unit heaters; ST Type pilot burner.

New: Steamizer Oil Gun.

Representatives: John S. Zink, owner; Walter J. Combs, J. Arthur Moore, and Robert Reed, sales engineers.

For more information on these items, use reply card opposite this page

TO REQUEST MORE INFORMATION on any item reviewed in the preceding International Petroleum Exposition Directory, use the space below. Fill in the Key No. of the manufacturer (given with each review), and the Name or Description of the equipment or literature in which you are interested.

Be sure to fill in Your Name and Address at the bottom

KEY No.	NAME or DESCRIPTION (Please Print)

Use space ABOVE for information on equipment or literature shown at International Petroleum Exposition exhibits

Use Numbers BELOW for "What's New"

Issue of MAY, 1948

I am interested in the items reviewed in the "What's New" section of PETROLEUM PROCESSING as indicated by the numbers circled at the right. Please have the manufacturer send me more information or the literature offered.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50

Name (Please Print) _____

Position _____

Company _____

Street Address _____

City, Zone, State _____

THIS PORTION FOR INTERNATIONAL PETROLEUM EXPOSITION

For those readers who are unable to attend the International Petroleum Exposition, Tulsa, May 15-22, PETROLEUM PROCESSING has made arrangements to have exhibiting manufacturers send literature or more information describing equipment which they will have displayed.

Use special reply card above

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41	42	43	44	45	46	47	48	49	50

Name (Please Print) _____

Position _____

Company _____

Street Address _____

City, Zone, State _____

FOR MORE INFORMATION—use one of these reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the items you're interested in, fill in the rest of the card, and drop it in the mail. No postage needed.

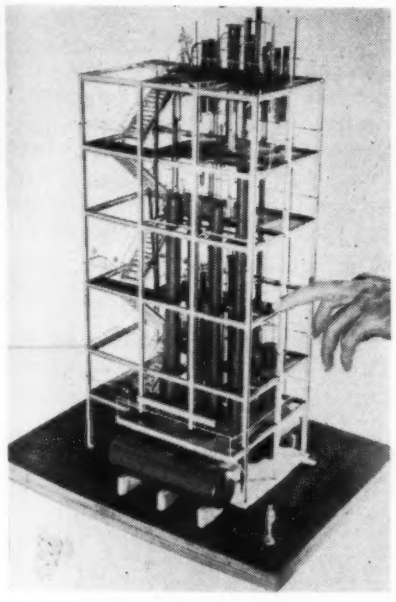
EQUIPMENT MATERIALS PROCESSES LITERATURE

What's New!

Reviewed by WILLIAM C. UHL, Equipment Editor

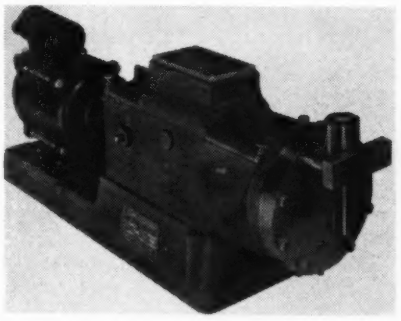
1—Scale Models

Helpful as an engineering tool is a new line of industrial scale models designed to cover all typical industrial equipment used including that in the refinery industry such as piping, instruments, valves, structural members, etc. A scale of ¼ in. to the ft. is usually employed. Models are built from blueprints or dimensioned flowsheets furnished the manufacturer by the purchaser. Industrial Models.



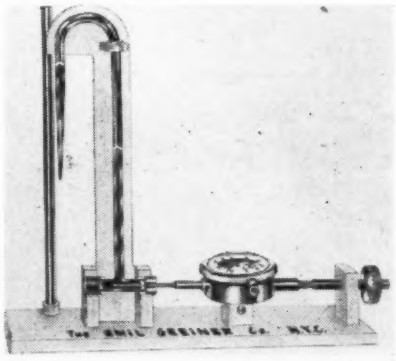
2—Proportioning Pump

The CP Model "Pulsafeeder" Proportioning Pump is a combination piston-diaphragm unit in which a piston reciprocating over a measured stroke displaces oil, which in turn pulsates a diaphragm. The hydraulically-measured pulsation of the diaphragm actuates the flow. Pump thus provides for positive displacement and measured feed with elimination of stuffing box and complete isolation of pump parts from fluid being handled. It is recommended for the following petroleum and petro-chemical applications: color correction of lube oils, continuous dye feeding for coloring gasoline, gum inhibitor feed, liquid catalyst feed, recycling of corrosive gases, and acid feed in alkylation. Four sizes provide capacities of up to 11, 40, 100, and 330 gals./hr. Various materials of construction are offered for different chemical requirements. Lapp Insulator Co., Inc.

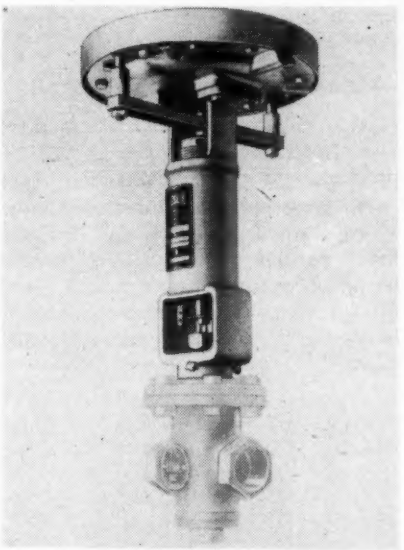


3—Microburette

Simple manipulation and precise rapid titration are said to be possible with the new "Gilmont Ultra-Microburet" which has a total displacement of 0.1 ml. with 1/10,000 ml. divisions. A precision ground plunger, actuated by a knurled-wheel adjustment, displaces mercury, in turn forcing the tiny quantities of solution through a fine orifice. A precision dial micrometer gage reads directly in volume units. The mercury reservoir is made as small as possible to reduce temperature fluctuations to a negligible amount. Back diffusion into the capillary tube is eliminated by the fine orifice. Burettes are also available on special order for total displacements of 1 ml. (in 1/1000 ml. divisions) or 0.01 ml. (in 1/100,000 ml. divisions). Emil Greiner Co.



4—Valve Reverser

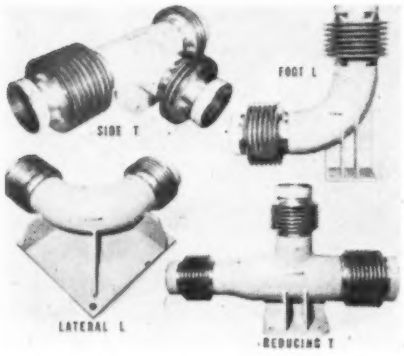


By substituting the new Reversing Superstructure for Diaphragm Regulating Valves for the standard superstructure, the valve action can be reversed without removing the valve body from the line. It is said to save many man-hours ordinarily required to remove the body from the line, remove the old gaskets, scrape the flange faces and invert the body. The new superstructure maintains the same valve characteristics, including minimum hysteresis, effective diaphragm area, and spring characteristic. Leslie Co.

More "What's New!" Items, Page 498

City, Zone, State

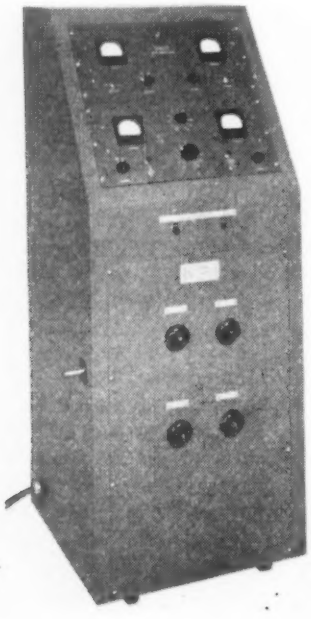
5—Expansion Fittings



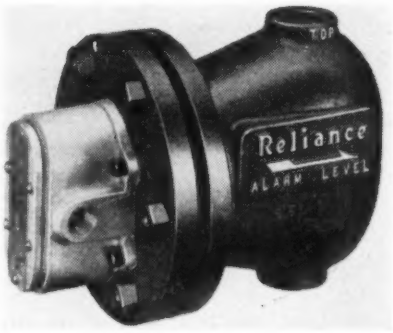
A new line of anchor base expansion joint pipe fittings has been added to the six standard series of "Magnilastic" packless expansion joints. Four typical units shown are a side tee, foot ell, lateral ell, and reducing tee, all in stainless steel. Installation time and costs are said to be saved by the minimum amount of welding required. The line will supplement regular Magnilastic joints made for a full range of pressures from 30 in. Hg. vacuum to 1000 psi. in pipe sizes from 1/2 to 72 in. Greater pressures and larger pipe sizes can be handled on special order. Cook Electric Co., Magnilastic Divisiion.

6—Leak Detector

The Veeco Mass Spectrometer Leak Detector is recommended for application wherever a vacuum, fixed pressure, or special atmosphere must be maintained in equipment for extended periods of time. Uses include testing of welds, glass-to-metal seals, high-vacuum and pressure systems, distillation equipment, valves, tanks and vessels, heat exchangers, condensers, instrument bellows, detection of porosity in metals, etc. Designed to analyze for the presence of helium, the instrument can easily "spot" leaks in either vacuum or pressure systems by detecting the helium in a flow of gas through such systems. Sensitivity is less than one part in 200,000 of helium in air. Operates on 115 volt, 60 cycle, AC power. Vacuum Electronic Engineering Co.



7—Level Alarm



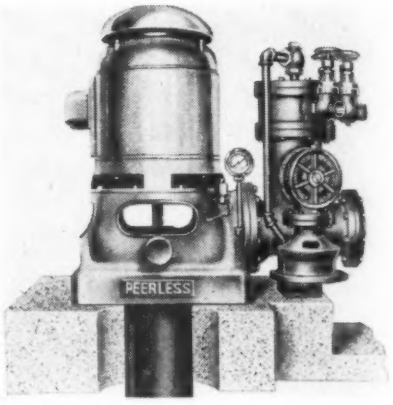
The "Levelarm" consists of an electric switch operated by a permanent magnet when a monel float rises or falls in the separate float chamber. It can be used on pressures up to 250 psi. to set off warning signals. The switch can be wired for a normally open or normally closed circuit, and is dust, vapor, and explosion-proof. Reliance Gauge Column Co.

8—Strong Refractory

Ability to support loads at high temperature is combined with usual refractory properties in a new chrome-base refractory concrete, "Kromecast". It can be poured or applied by plastering or with a gun and possesses volume stability at temperatures up to 3100° F. A second new product for use where temperature and spalling conditions are not so severe is "Hydrochrome", also a chrome-base concrete with a limit of 2800° F. Babcock & Wilcox Co.

9—Fire Pump

Full approval by the Underwriters' Laboratories, Inc., and the Associated Factory Mutual Fire Insurance Companies has been granted to Peerless Vertical Turbine Fire Pumps, it has been announced. Included in the approval are electric, right-angle gear, or steam turbine drive, and oil or water lubrication. Recommended for pumping from wells, tanks, lakes, rivers or sumps, the Peerless Fire Pumps are available in capacity ranges from 500 to 2000 gpm. to operate against heads from 240 to 285 ft. Peerless Pump Division, Food Machinery Corp.



10—Synthetic Air Hose

Useful life in flexible wire braid tubing for air hose is reported to be considerably lengthened by use of Buna and Neoprene base synthetics which will stand up under high temperatures, pressures, vibration, corrosive solvents, and fumes. One-quarter inch tubing will stand burst pressures to 1000 psi. and larger sizes proportionally less. Standard sizes are from ¼ to 2 in. I. D., and in a range of lengths up to 200 ft. in the small diameter and 50 ft. in the largest diameters. Tubing can be shipped within 72 hours after an order is received. Ronaflex Tubing Co., Inc.

More "What's New!" Items, Page 500

Refinery Piping from "A to Z" from the complete CRANE line

ONE
SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY

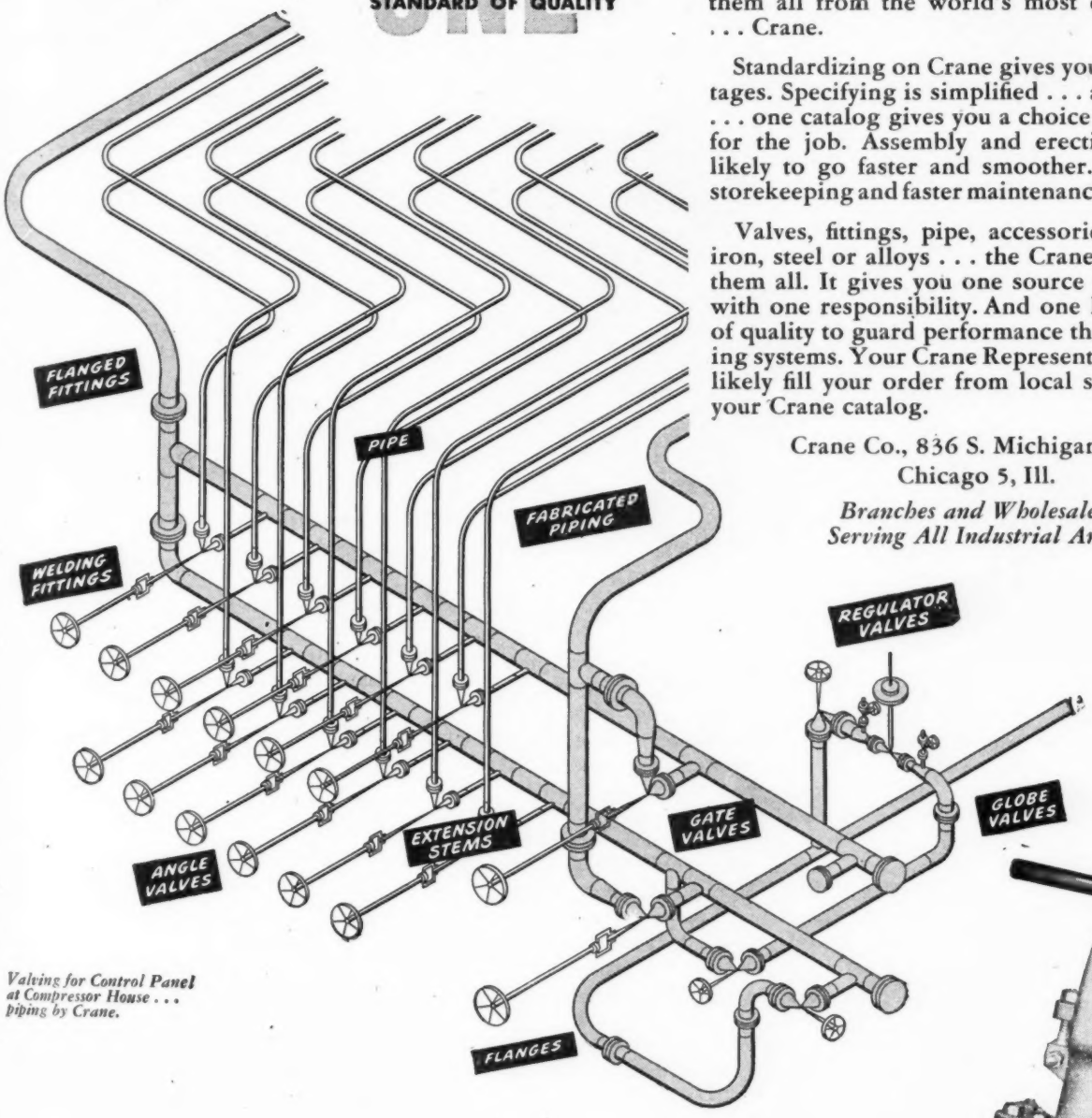
From big steel valves for high temperature lines to flange-bolts. From complex shop-fabricated manifolds to the simplest bends . . . you can get them all from the world's most complete line . . . Crane.

Standardizing on Crane gives you many advantages. Specifying is simplified . . . as is ordering . . . one catalog gives you a choice in everything for the job. Assembly and erection are more likely to go faster and smoother. Systematized storekeeping and faster maintenance are possible.

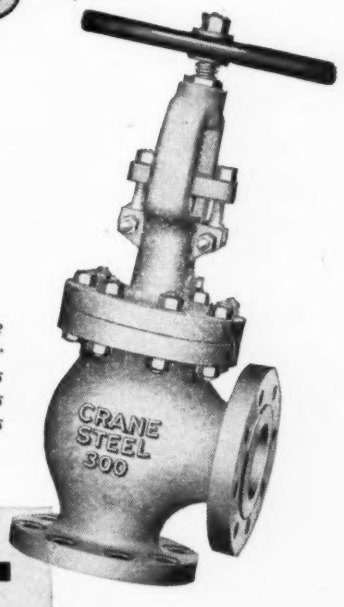
Valves, fittings, pipe, accessories . . . brass, iron, steel or alloys . . . the Crane line includes them all. It gives you one source of supply . . . with one responsibility. And one high standard of quality to guard performance throughout piping systems. Your Crane Representative can most likely fill your order from local stocks . . . see your Crane catalog.

Crane Co., 836 S. Michigan Ave.,
Chicago 5, Ill.

Branches and Wholesalers
Serving All Industrial Areas



Valving for Control Panel at Compressor House . . . piping by Crane.



RUGGED AND SUBSTANTIAL *for refinery services, Crane Cast Steel Globe and Angle Valves, for 300 pounds oil or oil vapor. Crane meets your specifications in all steel valves . . . gates, globes, angles, checks . . . in pressure classes from 150 to 2500 pounds . . . with proved trim materials for all services. Flanged, screwed or welding ends.*

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

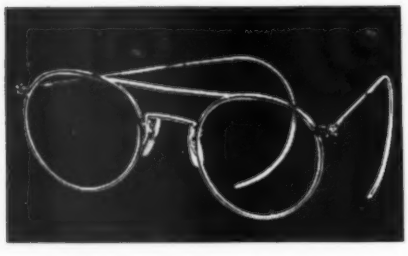
CRANE

FOR EVERY PIPING SYSTEM

11—Galvanometer

The new Type E galvanometer has its moving system, magnet, lamp, scale, and lamp transformer in a single, compact case. Once it is plugged into a 115 volt, 60 or 50 cycle outlet, it is ready for use. Available sensitivities are 0.5 microvolt, 0.005 and 0.0005 microamps./mm.; period is about 3 seconds. Scale has 50 one-mm. divisions on either side of zero; deflection is linear within 1%. Leeds & Northrup Co.

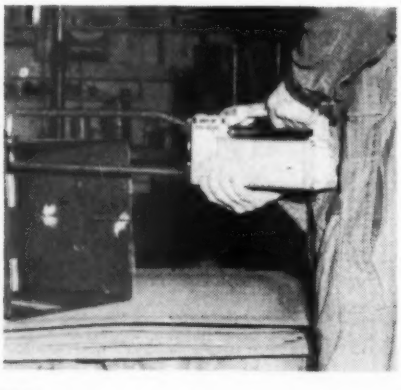
12—Plastic Safety Goggles



Made of a new type plastic for safety goggle use, allyl casting resin, the "Safe-T-Vis" features a lens approximately one-half the weight of a case-hardened glass lens. Goggles are available in four styles and a selection of frame sizes. Univis Lens Co.

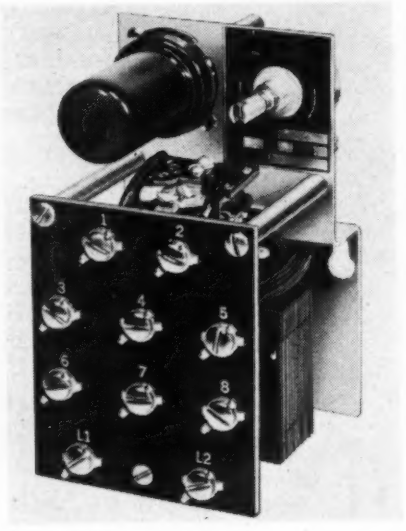
13—Portable Welder

Weighing 23 lbs. and recommended for quick welding jobs in hard to get at places, the Greyhound Portable Spot-welder will handle up to 1/8-in. combined thickness of metal. The tool is enclosed in a cast aluminum casing with an integral aluminum handle.



Three lengths of copper arms are available—6, 12, and 18 in., along with replaceable alloy tips in an assortment of shapes. Units are furnished in either 110 or 220 volts and with 10 ft. of cable. Greyhound A. C. Arc Welder Corp.

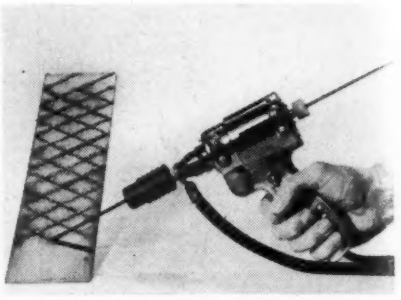
14—Relay Control



Applications cited for the new "Leveltronic" Relay include liquid level and interface control and alarm, pressure control and alarm, temperature control and alarm, and high foam control and alarm. The circuit is of the positive acting thyratron type, with the tube current limited to less than one-third its maximum value, for long life and low maintenance. Two models cover a range of from 20 ohms to above 2 megohms with continuously variable sensitivity giving 2 to 1 discrimination over the full range. The relay has a double-pole, double-throw action with heavy contacts capable of actuating up to a ½ hp. motor. Direct and reverse acting units are available. Construction is in accordance with NEMA standards, with the 6 volt control circuit completely isolated from the line. Actuating circuit is approximately one billionth hp. and is said to cause no heating, arcing, ionization, or chemical change. R-S Products Corp.

15—Surface "Rougher"

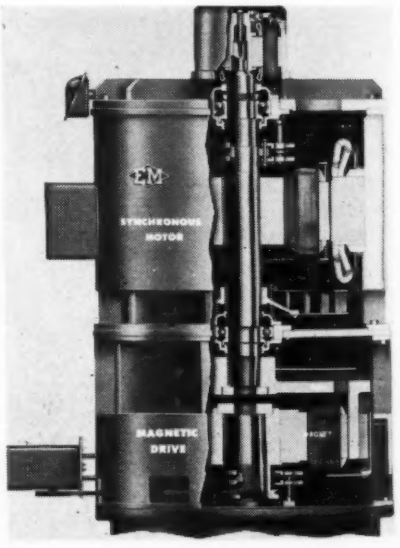
The "Ruf-Tred" tool is a vibrating electrode holder used with either AC or DC welding machines to deposit hard, rough bead lines about 1/8-in. wide and 1/16-in. high on smooth



steel or iron surfaces as a means of preventing slipping and falling accidents. Bead lines can be spaced several inches apart and arranged in a geometrical pattern, or can be spaced closely in parallel lines. In operation, the end of the electrode is placed in contact with the surface to be roughened and drawn along at about 5 ft./minute. It is not necessary to "hold" an arc as in welding, because the vibrations cause intermittent arcing. Metallizing Engineering Co., Inc.

16—Adjustable Drive

A new vertical synchronous motor magnetic drive unit is said to give smooth adjustable speed control for centrifugal pumps. The motor drives the ring of the magnetic drive at constant speed. Magnet member of the magnetic drive, mounted on a gear shaft, operates the pump at the speed required by the liquid level control. Unit is said to preclude "hunting" and eliminates frequent motor starts and stops. Cutaway shows a 250 hp., 1200 rpm. unit operating a 200 rpm. vertical sump pump through a reduction gear. Electric Machinery Mfg. Co.



More "What's New!" Items, Page 502

"The Battery For Today!"
WORTHINGTON
One of many plants using Worthington multiple compressor installations in the processing of gases

THAT KEEPS AIR-COSTS FROM PILING UP A SCORE

The more compressed air or gas you use, the more you can economize with Worthington Opposed Steam Driven Compressors. With over 50 years of development behind them, these rugged, tireless performers are up-to-the-minute in every last cost-saving detail. For example:

Pressure feed lubricates each side independently, reducing outage and maintenance to a minimum . . . full accessibility to all steam and air cylinder interiors by removal of rear cylinder heads only . . . modern, trouble-free bearings for uninterrupted service . . . and Worthington Feather* Valves, most efficient ever made.

Reduced Labor and Maintenance Costs

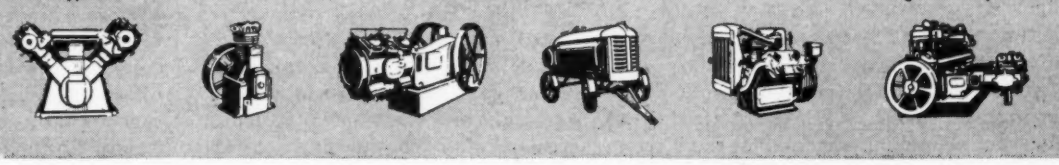
Following the Worthington formula, these modern Compressors combine high performance efficiency with minimum maintenance requirements. Their ability to do a better job, year after year, on amazingly low operating costs is familiar proof that *there's more worth in Worthington.*

Write for Bulletin L-680-B1A. *Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, New York.* K7.7

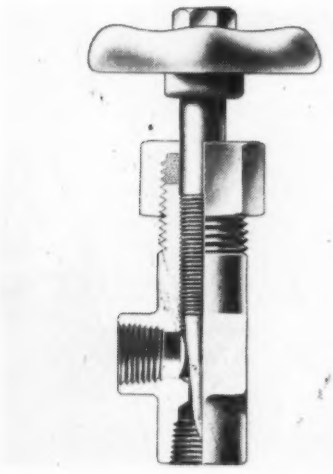
WORTHINGTON

*Reg. U. S. Pat. Off.

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON

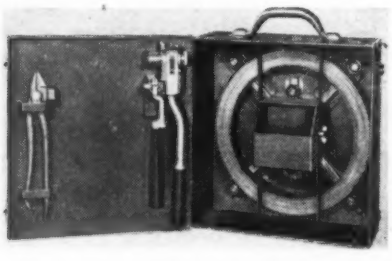


17—Metering Valve



The new "Bulldog" needle valve is built with a stainless steel stem and has the longest practical taper possible in a valve of its length, according to the manufacturer. For precise control, a micrometer thread has been machined on the stem, allowing movement in tenths of a thousandth. Two models are available—with female ends and with union outlet—in 1/8 and 1/4-in. sizes. Carpenter Mfg. Corp.

18—Strapping Kit



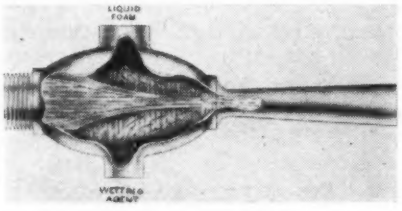
Recommended as a handy tool for fastening insulation on refinery piping, the Gerrard "Strap Kit" consists of a light, portable dispenser for steel strapping, and contains a "Steeelbinder" Strapping Tool and Cutter. The strapping is unreeled through a small slit on one end of the steel case. The unit is 14 in. high, 12 in. wide, and 5 in. deep, and fitted with a handle. A. J. Gerrard & Co.

19—Agitated Reactor

The "Standard-Plus" Agitated Reactor line can be furnished in a wide range of materials, sizes, agitator types, and with all necessary auxiliary equipment. Units are made in compliance with ASME Code for weldable material such as steel, stainless steel, monel, nickel, inconel, or clad steels. Turbine, propeller, or anchor and paddle agitation can be furnished, depending on processing problem to be met. Facilities are included for direct or indirect heating by oil, gas, steam, electricity, or Dowtherm. Unit shown is 2000 gal. capacity, made of type 316 CB clad stainless steel, and has a Dowtherm jacket working pressure of 75 psi. and an internal working pressure of 100 psi. or full vacuum. Industrial Process Engineers.

20—Foam Mixer

The Aladdin Model AA Proportioner Assembly automatically introduces either liquid foam or wetting agents into fire streams in the proportions desired without disassembling the equipment. Its operation gives fixed mixtures at 30 to 125 psi. pressure with fog or straight steam. It can be installed on existing equipment on lines up to and including 1½ in. Body is chrome plated bronze. Aladdin Engineering Equipment Co.



Trade Literature

21—Compressors

Process Compressors, Form 3132, illustrated with installation pictures of air and gas compressors in service in chemical, process, and petroleum industries; also shows line of 15 basic types of machines from ½ to 30,000 hp. sizes. Ingersoll-Rand Co.

22—Water Softener

Cochrane Rapid Reactors, Pub. 4425, describes the new cold process water softener which combines mixing, floc formation, settling, and thickening in a single vessel, and is available in three size ranges—to 100 gpm, 100 to 500 gpm, and 500 to 3000 gpm. Cochrane Corp.

23—Electrical Connector

R-C-E Rubber-Clad Electrical Connector, Bulletin 201, describes a plug-and-receptacle type industrial connector which cannot be pulled apart except by twisting from a locked position. Industrial Power & Equipment. Co.

24—Boiler Design

Recent Boiler Design Practice, Bulletin 3-407, a 24-page paper on that subject, presented at the West Virginia Section ASME Meeting, April 28, by W. H. Rowand, and illustrated with tables, diagrams, and charts. Babcock & Wilcox Co.

25—Ammonia in Oil Industry

Ammonia in the Petroleum Industry, a 44-page illustrated booklet explains in detail the uses of anhydrous ammonia by refiners in corrosion control, refrigeration, treatment of light distillates, neutralization of acid treated oils, fluid catalytic cracking, and the like. It gives physical and chemical properties and precautions for safe handling and use. Mathieson Alkali Works, Inc.

26—Vessel Assembly

Field Assembly of Pressure Vessels the SMITHway, Bulletin No. V-44, a 24-page booklet presenting an interesting picture story of the shop fabrication of parts, methods of shipment, and field assembly of pressure vessels for the refining industry. A. O. Smith Corp.

27—Expansion Joints

CMH Expansion Joints, Bulletin EJ-47-R1, covers revisions in previously issued booklet covering axial and lateral motion, temperature, and pressure specifications. Chicago Metal Hose Corp.

28—Hydrocarbon Prices

Price List No. 6, effective March 1, 1948, brings up to date the charges, conditions of sales, shipping data, and other information on Phillips' hydrocarbons and aliphatic sulfur chemicals. Phillips Petroleum Co.

NEW BOOK—NOW READY for immediate delivery . . .

"INDUSTRIAL WASTE DISPOSAL

for

Petroleum Refineries and Allied Plants"

Disposing of industrial wastes is a never-ending problem—yet there has been a surprising lack of up-to-date information and authoritative reference data on this important subject.

For that reason, "INDUSTRIAL WASTE DISPOSAL" is a book that fills a real need and will be welcomed by all engineers and technicians who are concerned with effective, economical control and disposal of harmful wastes.

The author—W. B. Hart—is a widely recognized and highly respected authority in this field, having been actively engaged in solving the problems of industrial waste disposal for the past 20 years. Mr. Hart is a graduate of the University of Pennsylvania with the degree of Doctor of Pharmacy. With Atlantic Refining Company since 1923, he has charge of waste disposal for his Company, and is Chairman of the Committee on Disposal of Refinery Wastes of the American Petroleum Institute.

"INDUSTRIAL WASTE DISPOSAL" is a complete treatise, starting with a brief review of the economic and legislative backgrounds; then a full discussion of the kinds of industrial wastes and their harmful effects; and right on through the "how" of proper waste disposal.

There is a wealth of reference information and operating facts in this book; over 100 pages (8½ x 11) of material, presented clearly and logically under these main divisions . . . .

ECONOMIC and LEGISLATIVE ASPECTS

KINDS OF WASTES

EFFECTS OF INDUSTRIAL WASTES

PRELIMINARY INVESTIGATIONS

TREATMENT OF OIL-CONTAINING WASTES

The text of "INDUSTRIAL WASTE DISPOSAL" was first published as a series of articles in Petroleum Processing magazine, intended primarily for refinery engineers; however, a large part of the material is so basic that it is applicable to all kinds of waste control—whether in a refinery, a dairy, a tannery or other type of industrial plant.

Methods for determining, measuring and controlling industrial wastes are covered in a thorough and wholly practical way, with appropriate sketches and diagrams.

For the man who works directly on industrial waste control, this new book is a valuable 'on-the-desk' ready reference; and it is a useful addition to the general library of all plants having a waste control problem. Finding quick answers to specific problems is facilitated by a detailed index; and the bibliography of 174 references is a real help when it is necessary to dig fully into the details of a particular phase of the general waste disposal problem.

"INDUSTRIAL WASTE DISPOSAL" is the most complete and up-to-date book on this important subject . . . 68 detailed illustrations, 11 tables, 103 pages, 8½ x 11, attractively bound in stiff cloth covers, with the title stamped in gold on front cover and backbone . . . a convenient, practical desk reference and a valuable addition to any technical reference library, private or public . . . . $4.00. *Ohio purchasers, please add 3% sales tax.*

PETROLEUM PROCESSING

1213 West Third Street **Cleveland 13, Ohio**

29—Forged Steel Valves

Forged Steel Valves, Catalog 48FS, gives 16 pages of data on design and construction, ratings, markings, and prices on a line of 600 lb. forged steel valves in gates, globes, angles, and checks in screwed, flanged, and socket-weld types, and with various types of trim. Ohio Injector Co.

30—Isotopes

Eastman Isotope Concentrates, a four-page pamphlet describing stable isotope compounds useful in mass spectrometer work. Included are Carbon 13—6000 potassium cyanide; Carbon 13—6010 methyl iodide; Carbon 13—6020 barium carbonate; Nitrogen 15—6030 ammonium nitrate; and Nitrogen 15—6040 potassium phthalimide. Prices and shipping information also given. Eastman Kodak Co., Organic Chemical Sales Div.

31—Swivel Joints

Chiksan, Catalog No. 48, on a complete line of ball-bearing swivel joints, accessories, and replacement parts; rotary hose; and rotary hose swivel joints. Joints are for pressures up to 12,000 psi, at 225° F., and for 700 psi. at 500° F. Chiksan Co.

32—Colorimeter

Determination of Color Index of Lubricating Oils, Kerosenes, and other Petroleum Products, Bulletin 480, describes use of the "Lumetron" Photoelectric Colorimeter Model 402-E in a test method recently proposed by the American Society for Testing Materials. Photovolt Corp.

33—Impervious Graphite

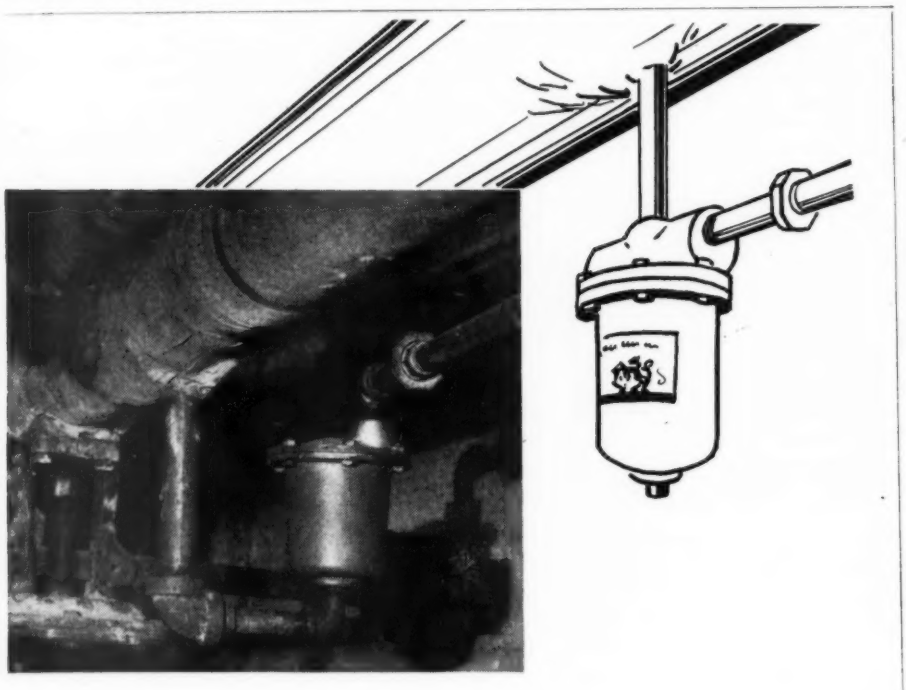
Falls Impervious Graphite for Corrosion Resistant Heat Exchange, six pages of drawings and specifications for plate heaters, concentric tube heat exchangers, 7-tube heat exchangers, bayonet heaters, pipe and fittings made of a resin-impregnated graphite suitable for most corrosive conditions and up to 300° F. and 50 psig. Falls Industries, Inc.

34—Nickel Steel Alloys

The Properties of Heat Treated Wrought Nickel Alloy Steels is a revised and enlarged edition of Bulletin P-1 on the same subject, first issued about 1936. It contains new data, largely in the form of charts, on the properties of the more commonly used steels containing up to 5% Nickel, and information on heat treatment methods. International Nickel Co., Inc.

35—Centrifugal Pumps

Nagle, Bulletin No. 4711, is 36 page descriptive bulletin on a line of heavy-duty centrifugal pumps; includes specifications, weight, dimension, and application data. Nagle Pumps.



That could be simplified with

SUPER-SILVERTOP

Even a simple installation such as that above, dripping a main, can be simplified, to your profit, with a Super-Silvertop inverted bucket Steam Trap. Notice the saving in fittings, think of the difference in installation time. Even if you included a strainer in the change-over, the new simpler job would use less fittings and cost no more.

You get *important* savings with Super-Silvertops in a trap that has *no* cored passages, one that can be used either as an elbow or straight-in-line, a trap that is years ahead in engineering advantages even after imitation has set in.

Let us tell you more about the details and advantages of Super-Silvertop Traps—write for a copy of "How To Choose A Steam Trap," a helpful book no matter whose steam traps you buy. It is sent free on request.

THE V. D. ANDERSON COMPANY

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For Your Convenience

Business reply cards are included in this issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "Whats' New!" You'll find them facing page 497 on the combination reply card designed for both the "What's New!" and the *Directory of Refinery Equipment Exhibitors* for the International Petroleum Exposition. Just circle the numbers corresponding to the numbers on the items you're interested in, fill in the bottom of the card, and drop it in the mail. No postage required.

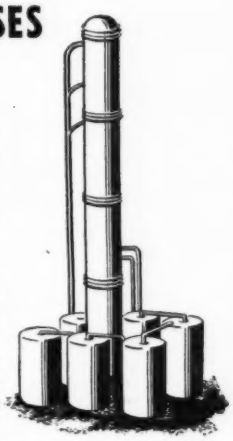
Announcing

SWIFT'S FATS and FATTY ACIDS

for technical uses

Swift & Company is now inviting inquiries on its new lines of fatty acids and fractionated glycerides. Extensive use of solvent processes will make possible new high standards of purity and stability.

1 THE PROCESSES



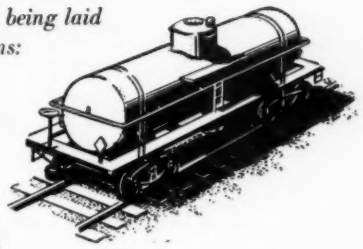
Solvent processes yield fat fractions of higher quality and wider usefulness. Most of Swift's new fats and fatty acids will be processed with solvents.

Unsaturated acids and drying oils will be separated by the Solexol process, using propane as a solvent. Fractions are separated selectively at temperatures not exceeding 200 degrees F. Since thermal and chemical side reactions are thereby avoided, products of greater purity and stability are obtained.

Saturated acids will be fractionated by solvent crystallization. Here, too, processing temperatures are low and harsh catalysts are absent, so that the natural structure of the substances is preserved.

2 THE PRODUCTS

Production plans are being laid for the following items:



Swift's Mixed Fatty Acids
Swift's Cottonseed Fatty Acids
Swift's Animal Fatty Acids
Swift's Linseed Fatty Acids
Swift's Corn Oil Fatty Acids
Swift's Soybean Oil Fatty Acids
Swift's Palm Oil Fatty Acids
Swift's Hydrogenated Marine Oil Fatty Acids

Swift's Fractionated Fatty Acids
Swift's Stearic Acid
Swift's Oleic Acid

Swift's Drying Oils
Swift's Fractionated Sardine Oil
Swift's Fractionated Menhaden Oil
Swift's Fractionated Soybean Oil
Swift's Fractionated Linseed Oil

Other Swift Glycerides
(*now in production*)
Swift's Lard Oils
Swift's Tallow Oil
Swift's Marine Oils
Swift's Neatsfoot Oil
Swift's Sperm Oil

Specialties
(*now in production*)
Swift's Sulfonated Sperm Oil
Swift's Sulfonated Tallow Oil
Swift's Sulfonated Castor Oil (Turkey Red Oil)
Swift's Sulfonated Neatsfoot Oil
Swift's Spermaceti
Swift's Textile Oils
Swift's Anti-foam Agents

3 SWIFT'S TECHNICAL PRODUCTS SERVICE

It brings you:

Representatives who know your problems and requirements.

Product technicians available for consultation on any Swift technical product.

Exploratory research developing products to further increase the efficiency of your operation.

This team is at your service now. Make use of it today!

Address inquiries to:

SWIFT & COMPANY

INDUSTRIAL OIL DEPARTMENT
Union Stock Yards, Chicago 9, Ill.

Insulated Joint Performs Favorably At Temperatures Well Over 950° F.

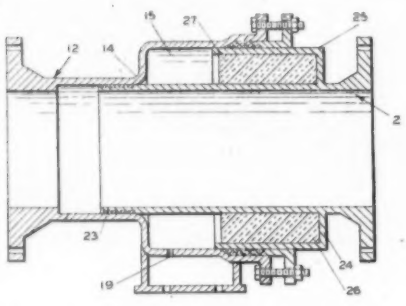


Fig. 1—Insulated expansion joint which is suitable for temperatures over 950 F. (U. S. 2,438,312)

SATISFACTORY HANDLING of hot fluids in refinery piping at temperatures well in excess of 950° F. is claimed for an expansion joint of the sliding piston type which includes insulation around a portion of the joint itself, as well as a pocket of dead air.

One form of the invention is shown in Fig. 1. The female, or socket, member 12 of the expansion joint is flared outwardly at 14 to provide an additional socket 15. Male member 21 fits socket member 12 in the conventional manner with ring packing at 23.

Made as an integral part of member 21 is a flange 24 with extension 25 at right angles to the flange, forming another socket 26 which contains insulating material in the form of rock wool 27. A conventional packing gland arrangement completes the unit.

In operation, any small amount of fluid which does get past rings 23 passes into dead air chamber 15 where it loses temperature rapidly. An opening 19 is provided in chamber 15 for draining off any small leakage.

U. S. 2,438,312, issued March 23, 1948, to George P. Bunn and Howard J. Pankratz, assignors to Phillips Petroleum Co.

Lower Cost Claimed as Feature Of Balloon-type Lifter Roof

REDUCTION IN COST of fabric and the elimination of bending stresses are accomplished in a balloon-type lifter roof design in which the flexing ring is a composite structure of both fabric and flexible sheet metal.

The roof is shown in three positions in Fig. 2—from minimum to highest expansion. Lifting section 13 is connected to the tank walls by a composite ring 20 which consists of metal member 21 and fabric members 23 and 25.

As the roof moves upward, metal member 21 of course buckles as indicated, but the bending stresses are confined within itself and not transmitted to other parts of the structure because the fabric members take up sufficient slack to permit corrugation. The metal member may also be in segments connected to each other by fabric as well. A minimum amount of fabric is required, reducing the cost over that of conventional lifter roofs, it is said.

U. S. 2,437,238, issued March 8, 1948, to Harry C. Boardman, assignor to Chicago Bridge & Iron Co.

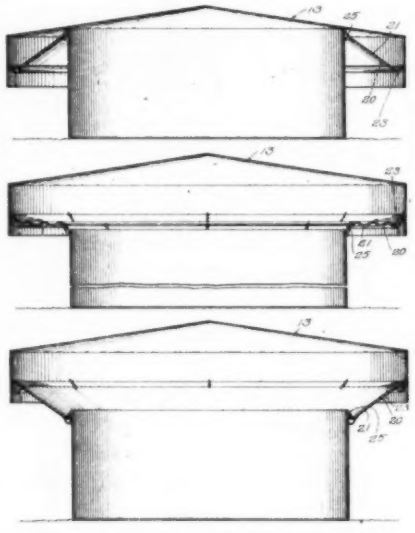


Fig. 2—Three positions of expansion in an improved balloon-type lifter roof design (U. S. 2,437,238)

Obtain Increased Compression In Blower with Three Rotors

AN IMPROVED BLOWER or pump of novel design for air or other fluids incorporates three interengaging impellers, and is said to be able to deliver fluid under substantially increased pressure.

As shown in Fig. 3, it consists of two impellers of general elliptical shape and a third of conventional lobed shape. All impellers, or rotors, are driven synchronously by a train of intermeshing gears of identical diameter, as indicated by the broken lines at 17, 18, 19 and 20.

Fluid flow and the direction of rotation of the impellers is shown by the arrows. Because the space for the entrapped air is constantly decreased through each cycle of movement from inlet to exhaust, a substantial compression results by the time the fluid reaches outlet 27 and passes through check valve 28.

U. S. 2,437,658, issued March 9, 1948, to Alfred O. Williams, Battle Creek, Michigan.

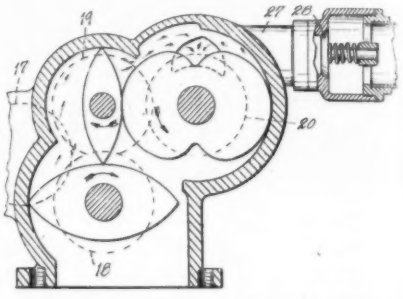


Fig. 3—Blower type pump for increased compression using three rotors (U. S. 2,437,658)

Cooling Tower Height Is Reduced By Airfoil-shaped Inlet Louvres

EMPLOYING AIRFOIL-SHAPED louvres on the air inlet grid of an induced draft cooling tower practically eliminates drift losses and makes possible a reduction in the height of the air inlets of about 55% as compared with conventional design, it is stated.

This reduction in inlet spacing does not affect the tower efficiency and is reflected in an overall decrease in the tower height and the amount of construction materials needed.

The louvres are shaped to a specific contour corresponding to Airfoil No. 6521 of the National Advisory Committee for Aeronautics. They are shown in cross section in Fig. 4. Flow of intake air is from left to right as indicated by the arrows.

The concave lower surface has good lift characteristics with a low coefficient of drag. The upper surface has a slope inward to the tower and has an action comparable to that of a sill. This, together with the high wiping velocity generated over the

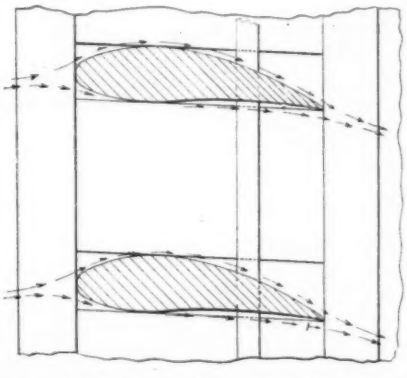


Fig. 4—Cross section of cooling tower inlet louvres shaped to an airfoil contour (U. S. 2,437,484)

upper convex surface tends to convey any water deposited on the louvre into the tower.

A vertical dowel to prevent warping may be cylindrical in form, although a streamlined, or tear-drop shape is preferred.

U. S. 2,437,484, issued March 9, 1948, to Edward W. Simons, assignor to one-half to George W. Null, San Francisco, Calif.

One-handed Operation Permitted By Thumb-operated Jaw Wrench

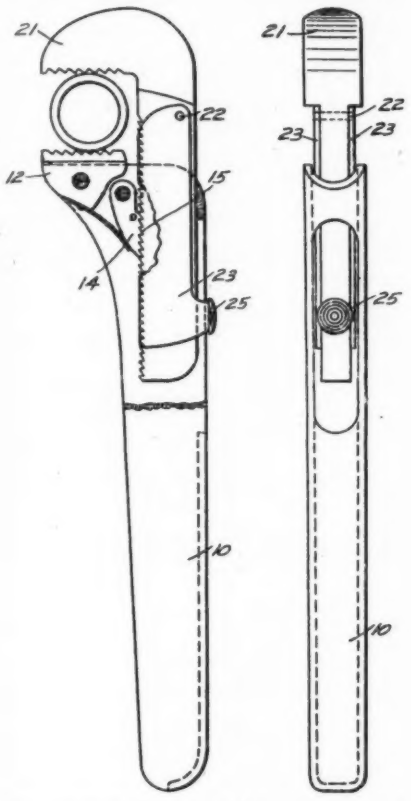


Fig. 5—Front and side views of thumb-operated, adjustable jaw wrench (U. S. 2,437,801)

AN EASILY MANIPULATED jaw wrench is capable of one-handed operation both in adjusting and using it. It incorporates a thumb-operated adjustment in a convenient position on the handle, and is illustrated in Fig. 5.

Handle 10 is hollow and has a slidable, tiltable head 21 mounted in the upper end. Head 21 is adjusted with respect to fixed jaw 12 by means of teeth 15 and toothed dog 14. The dog can be released at will by pressure on the thumb rest 25 on yoke 23, which straddles head 21 and is connected to it by pin 22. Upward and downward pressure of the thumb will open and close the jaws.

U. S. 2,437,801, issued March 16, 1948, to Thomas K. Andersen, Staten Island, N. Y.

Other Recent Patents

Space does not permit the complete review of all patents issued recently on equipment for the petroleum processing industry. Following, however, are brief abstracts of those with greatest interest:

Hydraulic Drum Jack consists of a metal cradle arrangement for gripping a drum in the upright position and lifting it by means of a device similar to a hydraulic automobile jack, the entire assembly mounted on a tricycle wheeled base. U. S. 2,437,982, issued March 16, 1948, to Tim Tietsema, Oveido, Fla.

Valve Construction for a spring-opposed-diaphragm type control valve using lightweight, easily assembled, sheet metal structure providing simplified fabrication, assembly, and maintenance. U. S. 2,437,552, issued March 9, 1948, to Francisco A. Quiroz, assignor to Kieley & Mueller, Inc., North Bergen, N. J.

Specific Gravity Indicator of the so-called rotameter type uses two metering floats; one being insensitive to specific gravity or viscosity but measuring rate of flow; and the other being insensitive to viscosity but being affected by variations in flow rate and in specific gravity. The differences in positions between the two floats are calibrated in terms of specific gravity for continuous recording. U. S. 2,437,247, issued March 9, 1948, to Kermit Fischer, Bridge Valley, Penna.

Floating Roof Tank Seal which is said to remain gas-proof although providing for both rise and fall of the roof deck as well as lateral drifting. The sealing fabric curtain's close contact with tank walls is maintained by spring arrangements mounted around periphery of deck. U. S. 2,436,942, issued March 2, 1948, to Edgar E. Shanor, assignor to General American Transportation Corp., Chicago, Ill.

Pipe Coupling permits quick replacement of gaskets or "blinds" without actually disconnecting the pipe sections. It consists of a permanent fitting containing a cam device for separating pipe ends, which is operated from the outside by a screw. Gaskets are inserted in a slot. U. S. 2,437,083, issued March 2, 1948, to Eddie M. Dons, Tulsa, and Jesse V. Stevens, Oakhurst, Okla.

Afterburning in Cat Cracker of the fluid type is prevented by eliminating the presence of combustible mixtures of oxygen and carbon monoxide in the light phase zone of the regenerator. Small percentages of carbon monoxide oxidizing catalyst, for example, copper, manganese, or cobalt oxides are mixed with the silica-alumina catalyst. U. S. 2,436,927, issued March 2, 1948, to Louis S. Kassel, assignor to Universal Oil Products Co., Chicago, Ill.

Floating Roof Tank Seal comprising blocks of highly buoyant foam glass material provided with wearing strips for sliding contact with the inverted conical face of the roof structure and the inner face of the tank walls. Mounting arrangement plus the buoyancy of the blocks forces them upwardly and outwardly against the tank wall. U. S. 2,437,125, issued March 2, 1948, to Fred L. Plummer, assignor to Hammon Iron Works, Warren, Penna.

Fluid Catalytic Cracking Unit in which the catalyst regeneration is conducted in an atmosphere devoid of free oxygen and in a readily controlled endothermic reaction, so that the danger of overheating and destroying the catalyst activity does not occur. U. S. 2,436,495, issued February 24, 1948, to Arthur D. Smith, assignor to Adsorptive Process Co., Chicago, Ill.

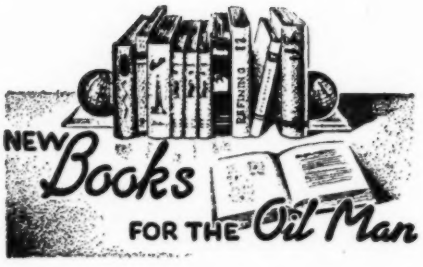
Mechanical Seal for centrifugal pumps operating at pressures in the range of 1000 psi. or more, in which the seal oil circulating pump is driven off the shaft which operates the main pump. U. S. 2,436,514, issued February 24, 1948, to Gerald P. Jennings, assignor to Phillips Petroleum Co.

Catalytic Conversion Unit provides for improved temperature distribution by passing the moving catalyst bed through a series of baffles, funnels, and distribution pipes after it leaves the hopper to which it has been fed by the catalyst elevators. U. S. 2,438,261, issued March 23, 1948, to Ernest Utterback, assignor to Socony-Vacuum Oil Co., Inc.

Centrifugal Pump which consists simply of a high speed rotating pipe extending down into liquid to be pumped and a concentric chamber at its upper end. Once primed, it draws liquid through by centrifugal force, passing it out through whirling hollow arms. U. S. 2,437,103, issued March 2, 1948, to John F. Leach, Childress, Texas.

How to Obtain Patents

Readers may obtain copies of any U. S. patents from the Patent Office at 25 cents each. Order by patent number from: The Commissioner of Patents, Washington 25, D. C.



Copies of all books reviewed here may be ordered from the Reader's Service Department, Petroleum Processing, 1213 West Third St., Cleveland 13, for the price listed, postpaid, unless indicated otherwise. Ohio purchasers please add 3% tax. U. S. Government publications should be ordered direct from the Superintendent of Documents, Washington, D. C.

Synthetic Fuels Covered Well In New First Text on Subject

Synthetic Petroleum from the Synthine Process, by B. H. Weil and J. C. Lane; 5½ x 8 in., 303 pages, indexed, stiff cloth binding, $6.75. (1948)

As is natural whenever a subject becomes sufficiently important, a book appears on the scene. Such is the case with synthetic liquid fuels, which are today attracting considerable attention—and the book is *Synthetic Petroleum from the Synthine Process.*

It is the first text published in this country, to the best of our knowledge, which treats any phase of the synthetic fuels picture completely. It is devoted strictly to the process for producing synthetic petroleum products by the catalytic hydrogenation of carbon monoxide. The authors elect, with arguments as to why, to call it the Synthine process; some readers may recognize it more readily as the basic Fischer-Tropsch reaction.

The voluminous data gathered by the authors is presented in four logical sections, well organized and referenced: (1) production and purification of the synthesis gas, (2) catalytic synthesis reactions, (3) products, by-products, and derivatives, and (4) basic economics and current developments.

If anywhere, it is in the latter section—economics and current developments—that the book falls short of being adequate. Although just released by the publisher late this past March, the book was apparently written over a year ago; at least the latest literature references indicate that nothing which has transpired since 1946 is included. In a field where so many developments have taken place during just the past year, therefore, it is not surprising that a good deal of the data included is already out-of-date. This criticism should not be construed as a reflection on the authors, considering the present delays and difficulties of the publishing business, but rather as a warning to the reader not to lean too heavily upon the data in the section in question.

One of the most valuable features of *Synthetic Petroleum from the Synthine Process* is the wealth of references it contains for the reader interested in further research on the subject. In addition to nearly 400 different listings in the individual chapter bibliographies, three appendices contain a classified list of over 2000 patents; an alphabetical, indexed list of government-released reports, and a supplemental bibliography of about 80 recent literature references.

About the authors—B. H. Weil and J. C. Lane: Weil is well known among readers of petroleum and chemical journals, having written a good deal for most of them. He is at present Research Associate Professor and head of the Technical Information Division, State Engineering Experiment Station, Georgia School of Technology. Lane is head of the Information Section in the Chemistry Division of Gulf Research & Development Co., a position which Weil himself previously held.

Four Experts Author New Text On Natural Gasoline Industry

Natural Gasoline and the Volatile Hydrocarbons, Section 1, by G. G. Brown, D. L. Katz, C. G. Oberfell, and R. C. Alden; 8½ x 11 in., 96 pages, stiff paper binding, illustrated, $4.00. Order direct from the Natural Gasoline Assn. of America, 422 Kennedy Bldg., Tulsa 3, Oklahoma.

This modern engineering textbook, *Natural Gasoline and the Volatile Hydrocarbons*, under the joint authorship of four well-known natural gasoline industry technologists, fills a long-felt need for an authoritative compilation of the technical aspects of natural gasoline manufacture. Two of its authors, Oberfell and Alden, Phillips Petroleum Co., wrote *Natural Gasoline* in 1924, which was the technical bible of the industry for many years. Dr. Brown is chairman, Dept. of Chemical and Metallurgical Engineering, and Dr. Katz, Professor of Chemical Engineering, University of Michigan, Ann Arbor. Much of the material in that book has been brought up to date and will be incorporated in the appropriate sections of the present work. Since 1924, operations have expanded and processes increased in complexity. The behavior of gas and natural gasoline hydrocarbons under pressure, the development of the cycling process at very high pressures and the handling of gas-condensate fluids brought great strides in technology.

The work has been divided into five sections, of which the first is in print and the second in preparation. The other sections will become available at approximately eight-month intervals.

It presents the properties of the volatile hydrocarbons and their application to natural gasoline and liquefied petroleum gas manufacture. Much of the essential data required by the design engineer has been compiled in convenient usable form, including 36 page-size charts, in Section 1, with a large bibliography for other authoritative data. The plant chemist will find it useful in checking operations. Students will find helpful its illustrations of data use, solutions to hypothetical problems and details of applying fundamental data in specific calculations.

Section 1 contains four chapters: Behavior of Petroleum Hydrocarbons, Fluid Densities, Vapor Pressure, and Critical Properties. Included are discussions of binary and complex mixtures, retrograde condensation, multiple phase systems, compressibility factors, pseudo-critical temperatures and pressures, effects of temperature and pressures, and the like.

Chapters in Section 2 include: Vapor-liquid equilibria, water-hydrocarbon phase relations, thermal properties, viscosity and surface tension. Section 3: Fractionation of hydrocarbons; absorption, adsorption and distillation. Section 4: Fluid flow and metering; and reservoir, behavior and reserves. Section 5: Natural gasoline and condensate operations and utilization of volatile hydrocarbons.

NFPA Issues Revised Code on Flammable Liquids and Gases

National Fire Codes, Vol. 1, Flammable Liquids, Gases, Chemicals, and Explosives, 1948 Ed., National Fire Protection Association, 5¾ x 9 in., 608 pages, stiff cloth binding, indexed, illustrated, $4.00.

The new 1948 edition of Vol. 1 of the *National Fire Codes* covers all revisions to December 31, 1947, and supersedes the two similar volumes dated 1943 and 1945 as well as the original codes for Flammable Liquids and Gases, edition of 1938.

It includes a number of new sections and codes not found in previous editions. Among the new subjects covered are gasoline fueling stations for small craft, control of gas hazards on vessels, farm storage of flammable liquids, and a table of materials subject to spontaneous heating.

This latter table was prepared by the National Fire Protection Association Committee on Spontaneous Heating and Ignition, and was officially adopted at the 1947 annual meeting of the NFPA. Information given for each material is as follows: tendency to spontaneous heating: usual shipping container and method

of storage; precautions; and general remarks.

As in the case of the previous editions, the work was compiled by Robert F. Moulton, technical secretary of the NFPA.

Scope Increased in New Edition Of Colorimetric Analysis Book

Colorimetric Methods of Analysis, 3rd Ed., Vol. I, Theory—Instruments—pH, by Foster Dee Snell and Cornelia T. Snell; 6 x 9 in., 262 pages, stiff cloth binding, indexed, illustrated, $4.50.

In the ten years that have elapsed since the second edition of *Colorimetric Methods of Analysis* was published, a tremendous amount of literature has been brought forth on this subject, particularly on photometry. As a result, both the scope and the size of the book have been increased, although much condensation was necessary.

Many of the older references from the second edition were deleted. Description of new equipment designs has been limited to the commercially more important types. The text itself has been expanded from two to three volumes, covering in this volume theory, instruments, and pH. Vols. II and III to follow will cover inorganic and organic applications.

The present volume includes data and methods on the various phases of photometry, fluorometry, hydrogen-ion, nephelometry, and turbidimetry, along with chapters on the theory of colorimetric methods.

The authors, Drs. Snell, have been engaged for many years as research consultants in New York City.

Colloid Chemistry Is Useful in Many Industrial Applications

Modern Colloids, by Robert B. Dean; 6 x 9 in., 314 pages, stiff cloth binding, indexed, $3.75.

Virtually all chemical products are either colloidal or are purified or otherwise treated by colloidal materials. Colloid chemistry has applications in work with high polymer plastics, in rubber, in detergents, in the purification and treatment of solvents, and in the disposal of waste and sewage.

Modern Colloids, though designed primarily as textbook for college students, both on the graduate and the undergraduate level, will be a useful desk reference for any chemist or engineer concerned with industrial applications involving colloidal materials.

Dr. Dean, the author, is assistant professor of chemistry at the University of Oregon.

1935 Study of Industry Control By the State Has Been Reissued

Our Enemy, the State, by Albert Jay Nock, 5 x 7½ in., 209 pages, stiff cloth binding. $2.50.

It is difficult to believe that *Our Enemy, the State* was first published in the heydey of the Roosevelt regime, a full year before the avalanche of votes that tore the country apart in 1936, leaving Maine and Vermont looking like two firm and adamant crags on an ocean-lashed point.

The fact that the book is still a forceful argument today under present conditions of threat to the free enterprise system has resulted in its recent reprinting. It is a "must" for every American, be he businessman, farmer, workman, or professional.

It is not, as its title or its scarlet wrapper might imply, the work of an anarchist. It is rather the studied expression of thoughts of a scholar, presenting in a logical, if perhaps too restrained, manner, the history of the omnipotent state.

Author Nock argues that much of the confusion existing in discussion on the science of politics is due to the lack of clear, concise definitions for the terms State and Government. He then applies his writing to that needed clarification of these terms by a careful examination of history—not the history of school books, but the history of business enterprises and their inter-relationships with political and ecclesiastical states.

When the book first appeared, attention was attracted to it chiefly because of its literary, rather than its sociological and philosophical, merits. The attitude of "it can't happen here" was too prevalent then. With the passing of over a decade of increasing power of the State, the book now stands more completely on its worth as a political thesis.

Dr. Nock died in 1945, before he had the opportunity to perform the revisions he planned for this second edition. As a result, it is an exact duplication of the earlier volume.

The author was for several years visiting professor at his alma mater, Stephens College, New York. He has been a clergyman, assistant editor of *The Nation*, and editor of the *Freeman*. "The State of the Nation," a well-known department of the *American Mercury* in the days of Henry L. Mencken's editorship, was written by Dr. Nock. Considered "both a die-hard reactionary and a Jeffersonian Democrat," Albert Jay Nock was once regarded as a liberal, and in later years as a conservative.

In contrast to his political studies, he also edited the works of two widely variant humorists—Rabelais and Artemus Ward. Among his other works are: *How Diplomats Make War, Free Speech and Plain Language, Henry George, Thomas Jefferson,* and *The Memoirs of a Superfluous Man.*

Commerce Department Analysis Studies Refining, 1940 & '46

United States Petroleum Refining—War and Postwar, by Winona Patton; 6 x 9 in., 137 pages, paper binding, $0.30. (Send all orders directly to Supt. of Documents, U. S. Govt. Printing Office, Washington 25, D. C.) (Nov., 1947)

U. S. Petroleum Refining is an analysis of this country's refining capacity in 1946 as compared with 1940, and of the change in ownership. It includes a discussion of the trends leading to the ownership of refining capacity by a fewer number of firms, detailed data on the geographical location of refining capacity in the two years covered, and a chapter on the outlook for the consumption of petroleum products in 1950.

The study was prepared by Winona Patton of the Industry Division of the U. S. Dept. of Commerce, and has been issued as No. 73 in the Commerce Dept.'s Industrial Series. Orders, as indicated, above, should be sent directly to the Govt. Printing Office in Washington.

MEETINGS
. . . for the Oil Man

May

4-5, American Gas Assn., Natural Gas Dept., annual spring meeting, Rice Hotel, Houston.

7, American Institute of Chemists, annual meeting, Waldorf-Astoria, New York.

9-12, American Institute of Chemical Engineers, regional meeting, Hollenden Hotel, Cleveland.

10-13, American Petroleum Institute, Division of Refining, mid-year meeting, Ben Franklin Hotel, Philadelphia.

10-13, National Fire Protection Assn., Hotel Statler, Washington.

15-22, International Petroleum Exposition, Tulsa.

June

1-6, Liquefied Petroleum Gas Assn., annual convention and trade show, State Fair Grounds, Sacramento, Calif.

6-11, Society of Automotive Engineers, semi-annual meeting, French Lick Springs Hotel, French Lick, Ind.

21-25, American Society for Testing Materials, 51st annual meeting, Book-Cadillac Hotel, Detroit.

August

18-20, Society of Automotive Engineers, west Coast meeting, St. Francis Hotel, San Francisco.

30-Sept. 3, American Chemical Society, 114th national meeting, Eastern Session, Washington.

September

6-10, American Chemical Society, 114th national meeting, Midwest Session, St. Louis, Mo.

13-17, Third Instrument Conference and Exhibit, Convention Hall, Philadelphia.

13-17, American Chemical Society, 114th national meeting, Western Session, Portland, Ore.

15-17, National Petroleum Assn., Hotel Traymore, Atlantic City, N. J.

15-17, American Institute of Chemical Engineers, regional meeting, French Lick Springs, Ind.

PERSONALS

Petroleum Technologists in the Headlines

Brig. General David N. Hauseman, U. S. Army retired, has been elected president of Houdry Process Corporation, Philadelphia, to succeed **Eugene J. Houdry,** founder of the Company. General Hauseman also will be chairman of the board of Catalytic Construction Company, subsidiary of Houdry Process Corporation.

Gen. Hauseman

Under a new policy the board of directors of Houdry Process Corporation will be made up exclusively of men working in the Corporation. The newly-elected directors are: General Hauseman; Arthur V. Danner, Executive Vice-President; Claude C. Peavy, Chief Engineer; John E. Ford, Manager of Commercial Development; Gordon A. Kessler, Manager of Patent Department; C. G. Kirkbride, Manager of Laboratories; T. Ellwood Webster, President of Catalytic Construction Company; George H. Daft, Comptroller; John D. M. Hamilton, Secretary and General Counsel.

Eugene J. Houdry, pioneer in the field of catalytic cracking of petroleum products has retired from the Company.

In taking over the presidency of Houdry Process Corporation and chairmanship of Catalytic Construction Company, General Hauseman leaves Temple University, Philadelphia, where he served as executive vice-president of the school and president of the Research Institute of Temple University. His headquarters will be in Philadelphia.

General Hauseman has had a long and distinguished military career, serving in both World War I and World War II. In military service he rose from Private to Brigadier General. He was District Chief of the Philadelphia Ordnance District for War Department.

General Hauseman was assigned to Headquarters, Army Service Forces in Washington, D. C., November, 1943, as Director of the Readjustment Division. He was also appointed, at that time, as Special Representative of the Under Secretary of War.

In recognition of his service, General Hauseman was awarded the Legion of Merit and the Distinguished Service Medal. He has received both the Army and the Navy Commendation Awards. On his own application, and after twenty-nine years of service, General Hauseman retired from the Army October, 1946.

General Hauseman received the degree of Bachelor of Science in Economics from the University of Pennsylvania and the degree of Bachelor of Science in Mechanical Engineering at the Massachusetts Institute of Technology. In 1935 he was awarded the degree of Master of Business Administration at Harvard. Temple University awarded him the honorary degree of Doctor of Science in 1944.

* * *

Dwight J. Evans has joined Branson Instrument, Inc., Danbury, Conn., as Chief Engineer, in charge of the development of new instruments for the petroleum trade.

After graduating from Kansas University with a Bachelor of Science in Electrical Engineering in 1938, Mr. Evans was connected with the Engineering Department of Phillips Petroleum Co., Bartlesville, Oklahoma from 1939 to 1948. He served in the U. S. Navy as aviation radar officer for three years, on military leave from Phillips Petroleum Co.

* * *

E. L. Howard, California Texas Oil Co. design engineer, is in France purchasing materials and supervising the ground design for the rebuilding of the Caltex refinery near Bordeaux. **F. W. Regan** is construction engineer in charge of the refinery being built near Rotterdam by Caltex. **F. W. Dittus,** Caltex chief engineer, headed the design work for both refineries.

* * *

James L. Huitt has been appointed to the Aluminum Co. of America Fellowship in the School of Chemical Engineering, University of Oklahoma. A graduate of Louisiana Polytechnic Institute, he is now an assistant in the chemical engineering school preparing for his master's degree.

* * *

After 41 years with Socony-Vacuum **Harold F. Sheets,** chairman of its board, has retired. **George V. Holton** has been elected to succeed Mr. Sheets as chairman of the board.

Mr. Sheets started as assistant to the managing director of Vacuum Oil Company's subsidiary in Germany. Later he became president of Vacuum's affiliated companies in France, Spain, Belgium and Italy and made his headquarters in Paris. He returned to the New York office of the company in 1924 and in 1930 was elected a director. He was elected chairman of the board of directors of Socony-Vacuum in 1944. Mr. Sheets will make his home in Santa Barbara, California.

Mr. Holton is a vice president and the general counsel of Socony-Vacuum. He left his law practice in Rochester, N. Y., to become assistant counsel for the Vacuum Oil Company in 1923. He became a director of that company in 1931 and the following year, upon the merger of Vacuum Oil Company and Standard Oil Company of New York, became the general counsel and a director of Socony-Vacuum. He was elected a vice president in 1938.

* * *

George Stuart Monroe, for the past 24 years a research chemist with the Universal Oil Products Company, died suddenly, February 25, at his home, 6526 Fairfield Avenue, Berwyn. He was 55 years of age.

Mr. Monroe

Mr. Monroe was graduated from the University of Illinois in 1917, with the B. S. degree in chemistry. His first position upon graduation was with the Newport Company, where he remained till 1924, when he joined Universal Oil Products Company.

His first published paper appeared in 1917, in "Industrial and Engineering Chemistry." Since 1930 he had worked in close collaboration with Professor V. N. Ipatieff, with whom he published numerous scientific papers dealing principally with reactions at high pressures and temperatures, such as synthesis of methanol from carbon dioxide and hydrogen, and solubilities of gases under high pressures.

His most recent contribution to the chemical literature was "High Pressure Laboratory Flow Apparatus." Many patents dealing with the treatment of hydrocarbons have been issued to him.

Mr. Monroe had a rare gift for making friends, and was highly esteemed by everyone who has known him as a chemist and as a man. He had been a member of Sigma Xi, Phi Lambda Upsilon, and a member of the ACS, since 1924.

He is survived by his wife, Edith Jensen Monroe.

* * *

Joseph F. Leddy Jr., acting assistant head of the Atmospheric Distillation Dept., Bayway refinery of Standard Oil Co. of New Jersey, has been given a special temporary assignment in the Mechanical Department and **William J. Wiseman** has been assigned as assistant head of

the Atmospheric Distillation Dept.

Mr. Leddy, a Norwich University graduate of 1934, joined the company as a student engineer and was a group leader in Bayway's Process Control Dept., when he entered military service. He returned to the company in January, 1946. Mr. Wiseman, a Johns Hopkins University graduate of 1933, started in as a Meter Repair Department helper at Baltimore refinery. He was transferred to the Chemical Products Dept. and became an administrative assistant there in 1944.

* * *

W. J. Devonshire, Jr., J. L. Quillen, Sr., and **R. F. Gourley,** are among employes given promotions at Marcus Hook by the Sun Oil Co. Mr. Devonshire is the new general foreman at 16 Plant; Mr. Quillen, foreman of Solvent Refining Section, and Mr. Gourley, supervisory foreman at 16 Plant.

* * *

George Gibson, appointed New York representative of Bechtel Corp., engineers and constructors, was a director of construction for PAW during World War II, and a consultant on refinery construction. Mr. Gibson received his education in chemical engineering at Rutgers and the University of Michigan. He joined PAW in 1941 as a material specialist for refining, and in 1944 became director in charge of construction for the government program of aviation gasoline production.

* * *

Dr. M. S. Agruss has been appointed Director of the Research and Development Department of the Precision Scientific Company in Chicago, Illinois. Previous to this appointment, Dr. Agruss was a consultant in the field of petroleum technology and chemistry, and was also a Research Supervisor with the Pure Oil Company for ten years. During the war years, he was a member of the Petroleum Industry War Council, as well as being associated with the Manhattan Project.

Mr. Agruss

* * *

C. E. Starr, Jr., assistant director of the Louisiana Division of Esso Laboratories, Baton Rouge, La., is the new chairman of the Baton Rouge section of the American Chemical Society.

CLASSIFIED

Petroleum Processing announces this classified section as a regular feature for the convenience of its readers. Classified rates are shown in the accompanying box.

Classified Rates

"For Sale," "Wanted to Buy," "Help Wanted," "Business Opportunities," "Miscellaneous" classifications, set in type this size without border—20 cents a word. Minimum charge, $5.00 per insertion.

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ADVERTISERS' INDEX

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Airetool Mfg. Co. 472
Allied Chemical & Dye Corp. ... Inside Back Cover
Aluminum Co. of America 396-424
American Cyanamid Co. 392
Anderson Co., V. D. 504
Attapulgus Clay Co. 420
Babcock & Wilcox Co. and/or Tube Co. ... 391-401
Badger & Sons Co., E. B. 432-433
Bethlehem Foundry & Machine Co. 439
Brown Fintube Co. ..... Facing Pg. 465
Calorizing Co. 482
Calumet Hecla Consolidated Copper Co. 440
Chapman Valve Co. 467
Chase Brass & Copper Co. 419
Chemical Construction Corp. 462
Chicago Bridge & Iron Co. ..... Facing Pg. 464
Chicago Metal Hose Corp. 471
Cook Electric Co. 469
Cooper-Bessemer Corp. 489
Crane Co. 499
Dresser Industries, Inc. 480
DuPont de Nemours & Co., Inc., E. I. Facing Pg. 448
Enjay Co., Inc. 445
Erie Bolt & Nut Co. 481
Ethyl Corp. 385
Foxboro Co. 452
General American Transportation Corp. 395
General Chemical Division of Allied Chemical & Dye Corp. ..... Inside Back Cover
Graver Tank & Mfg Co., Inc. 495
Griscom Russell Co. 479
Haering & Co., Inc., D. W. 477
Hammond Iron Works 468
Hudson Engineering Corp. ..... Inside Front Cover
Jones & Laughlin Supply Co. 484-485
Kellogg Co., M. W. 398-399
Koch Engineering Co. 456
Ladish Co. Center Spread of Insert Between Pgs. 464-465
Lukens Steel Co. 474
Monsanto Chemical Co. 386
McKee & Co., Arthur G. 402
National Annealing Box Co., ... 494
Nordstrom Valve Division ..... Facing Pg. 480
Petro Chem Development Co. 491
Petroleum Engineer 473
Petroleum Processing 503
Powell Co., Wm. 455
Pritchard & Co., J. F. 476
Process Engineers, Inc. 493
Quaker Oats Co. 390
Roots-Connersville Blower Corp. 470
Roth Co., Roy E. 481
Sargent & Co., E. H. 487
Sun Shipbuilding & Dry Dock Co. 434
Swift & Co. 505
Tube Turns, Inc. ..... Facing Pg. 416
Universal Oil Products Co. 388-389
Warner Lewis Co. 454
Wolverine Tube Divn. 440
Worthington Pump & Machinery Corp. ... 423-501
Wyatt Metal & Boiler Works ... Outside Back Cover

EDITORIAL VIEWPOINTS...

Opinions and Comments on Current Topics

Improving Octane Performance By Anti-Detonant Injection

THE POSSIBILITIES in achieving economical knock-free operation of engines by mechanical or other means, and without increasing the octane numbers of the motor fuels used, are coming in for more study as the cost to refiners of manufacturing the higher octane fuels becomes more generally recognized.

Results in improving octane performance through the injection of anti-detonant fluids into the fuel-air stream were reported by two agencies at the meeting in Fort Worth in March of the Natural Gasoline Assn. of America. The work has been directed both at obtaining knock-free operation of engines on low octane gasolines and also at furnishing satisfactory anti-knock performance in future high compression engines with present day fuel.

The automotive engineering group of Standard Oil Co. (Ohio) has been running dynamometer tests on a stock automobile engine with its compression ratio increased from 6.5 to 9, equipped with the Vita-Meter injection device manufactured by Thompson Products Co. Effects of anti-detonant injection have been studied and it has been shown in the work to date than an incremental octane improvement of 20 octane numbers or more can be achieved by this means.

Octane improvement of 10 octane numbers and higher in commercial fleet operations through anti-detonant injection were also reported at the Fort Worth meeting by a representative of the Thompson Vita-Meter Corp. Said Ray I. Potter, chief of the lubricant and fuel service division of Ohio Standard regarding the work by his company:

"If this engine is typical of other high compression engines in performance it would be at least technically reasonable to assume that injection could be relied upon to bridge the gap and furnish satisfactory anti-knock performance between present day fuels and future high compression engines requiring fuels in the range of iso-octane to satisfy their peak requirements."

Industry Support Needed to Bring Rizley-Moore Bill Before Congress

THE PETROLEUM and natural gas industries should lend their efforts to bring before Congress the Rizley-Moore bill defining the authority of the Federal Power Commission to regulate rates on gas moving in interstate commerce. Passed by the House late in 1947, the bill was pigeonholed in the Senate until a few weeks ago, when sponsors of the measure worked out a compromise bill to be reported to the Senate Judiciary Committee.

What has been said publicly on the bill so far has been mainly by representatives of the gas consuming interests. They have described the Rizley-Moore bill as an effort on the part of the large gas producing and pipeline corporations to take away a "victory" that gas consumers won in the Supreme Court decision in the Interstate Natural Gas Co. case. This is propaganda and far from the truth.

For the legitimate protection of the natural gas and casinghead gas producing and allied industries there is need for legislation along the lines of the Rizley-Moore bill. It is the duty of Congress to specifically define the lengths to which the Federal Power Commission may go in regulating the production and gathering of gas through the power of price fixing. If it is intended that FPC shall have extremely wide jurisdiction in the matter at least let it be so defined by law.

As matters now stand the gas producers—and also the cycling and natural gasoline plant operators—are in a twilight of uncertainty as to what the future may bring. The FPC itself adopted an administrative rule under which the so-called "arms length" sales of gas by independent producers and gatherers to an interstate pipeline are outside its regulatory powers. This is only its own disclaimer of intent. The FPC has also stated it has no intention of regulating the actual production of gas or oil. In the background, however, is a Supreme Court decision so sweeping as to suggest the possibility of subjecting to FPC regulation any producer or royalty holder who sells gas to a natural gas company either in the field or at the end of gathering facilities.

This is a most unhealthy situation for an industry to face and one not conducive to full conservation of our natural gas resources.

Will We Have the Technologists For a Synthetic Fuels Industry?

TECHNOLOGICAL manpower in large volume, as well as capital and materials of construction, will be an essential requirement for the development of a large-scale synthetic liquid fuels industry in this country. Providing the scientific brainpower in numbers to design and build and operate the plants would likely be the most difficult of all problems to overcome.

A long range and orderly development of the new industry can provide the time to train the chemists, engineers and other kinds of scientists required. Even so the training should not be left to chance but should have as much attention as any other feature of the program.

The synthetic liquid fuel refineries will be chemical plants using new catalysts and raw materials and calling for very precise operations. A large amount of analytical work for plant control, product specifications and other purposes will be required, all quite different from the experience of our present type refineries.

Technological manpower with the training for this new field could not be drafted from other industries even if the numbers were available, because of its specialized nature. However, we are now short about 100,000 scientific and technical manpower for industry in this country, due to the armed services taking men away from technical training and work during the war years.

So the technologists who will develop the commercial synthetic liquid fuels industry and who will build and run the plants in future years must be trained now, starting from scratch. The planning will be in the hands of the oil companies as will largely be the entire development of this new industry. It is a job that will require the cooperation of the oil companies and the technical schools and it is not too early to start now while the synthetic liquid fuels industry is in the embryonic stage.

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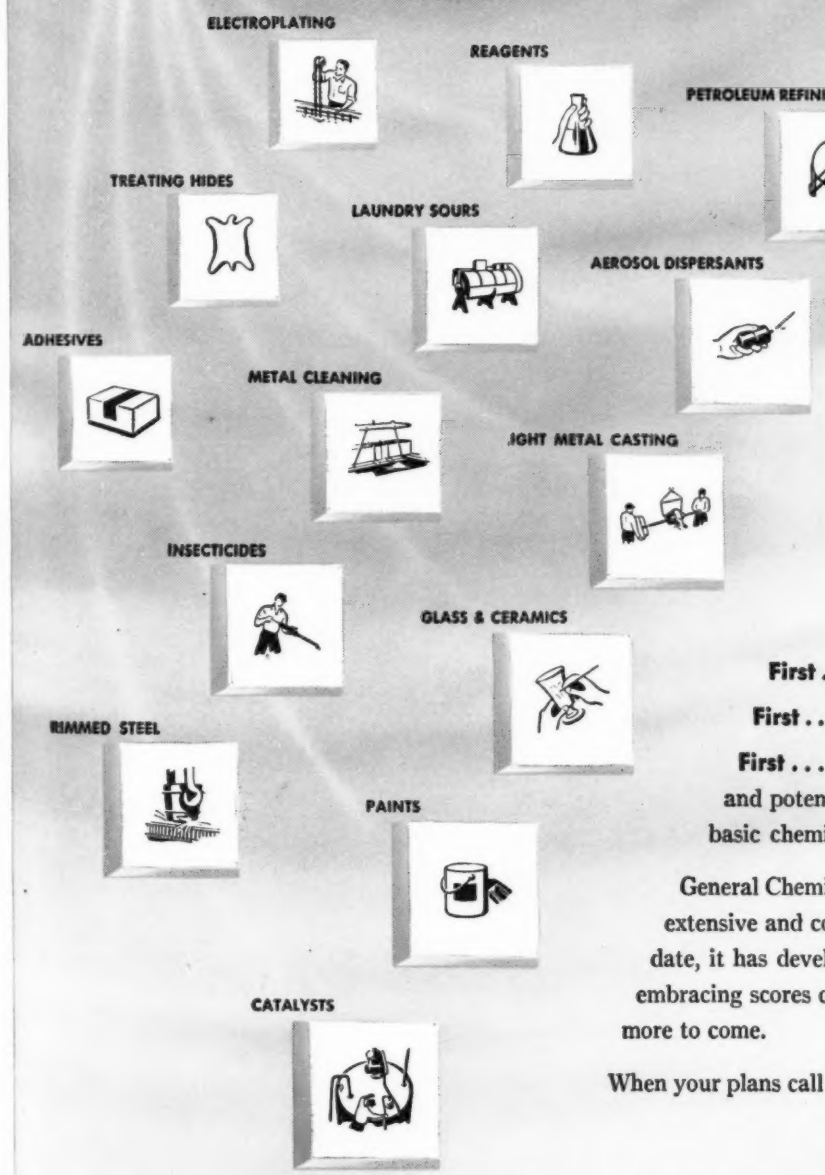

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